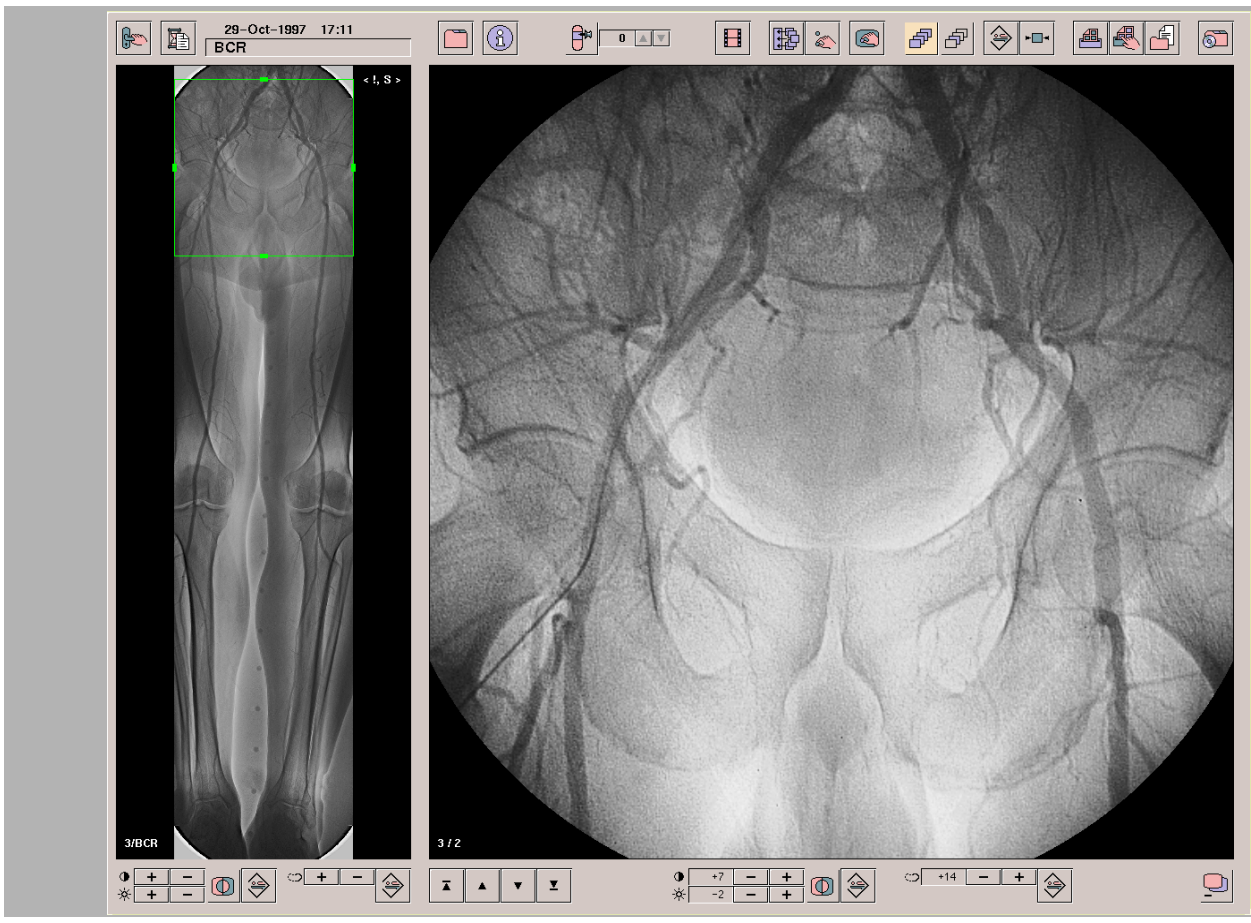
Digital Radiography



INSTRUCTIONS FOR USE

EasyVision RAD Software options

WORKSTATION FOR IMAGE PROCESSING

Release 4.2

English

4512 109 23322

PHILIPS

EasyVision RAD Software options

INSTRUCTIONS FOR USE

Release 4.2

English

Philips Medical Systems Juli 2000

PHILIPS

Instruction for use

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Chapter 1
Start-up and customizing

Automatic reconstruction

This option recognises an identifying alias, input with a series of images from an acquisition system (DSI, release 4.4 or later), and uses it to allocate a type of reconstruction (generation of an overall image from a series of overlapping images). Reconstruction can be applied to series of images in the R/F (colon reconstruction), bolus chase and spine application packages.

Extreme care must be taken when using the colon and bolus chase reconstruction images in diagnosis as the reliability of these images is limited.

Automatic reconstructions are identified by a recognition field, and may be edited or deleted.
To generate an automatic reconstruction alias.

Begin

- Click on the »New« button.

The »Reconstruction alias« panel is displayed.

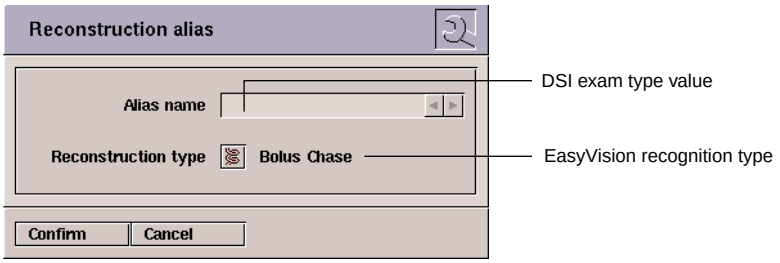


fig.1.1 Reconstruction alias parameters panel.

- Enter an Alias name as identifier, recognized by DSI.
- Right click the »Reconstruction type« selection button and select the reconstruction type from the pop-up panel. You can choose from
  - Bolus chase
  - Spine
  - Colon
- Click the »Confirm« button.
  The Reconstruction alias parameters panel is removed, and the »Automatic reconstruction« panel displays the new reconstruction with the recognition identifier in the »Alias« field.

End

Print protocol editors

When entering print protocols on the »Print protocol customization« panel, and the »New...«, »Copy...« or »Edit .« buttons are clicked, the print protocol editor panel for the application package appears. The procedures for editing print protocols are described in the following sections.

R/F view print protocol editor

Figure 1.2 shows the »R/F print protocol editor« panel. The fields on the panel are described below.

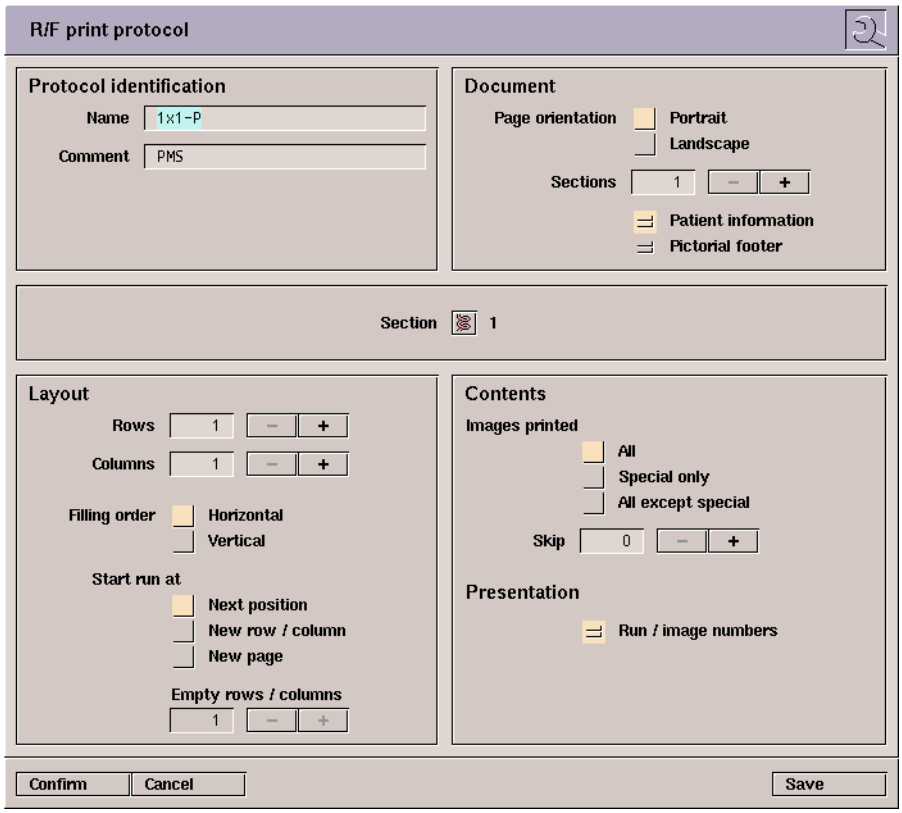


fig.1.2 R/F view print protocol editor

Protocol identification

Name / Comment
Enter a name for the print protocol. This name is used on the »Print protocol« and »Automatic printing« panels of the main Customization panel, and in the protocol print function of the application package, as an identifier for selection and editing.
Enter a comment in the Comment field. This comment is shown in the list of Print protocols on the customization panel.

Document

Page orientation

- Select the orientation of the films that will be produced (portrait or landscape).
  This selection applies to all films printed with the protocol.

Sections
In the R/F viewing package a print protocol may contain one or more sections. For each section you can independently set the layout and presentation parameters. Each print job will produce successive film sheets according to the section protocols.

- Enter the required number of sections.

Patient information
Patient information is shown in the header of each film.

- Click to turn on or turn off the patient information option.

Pictorial footer
For identification purposes, a small image can be printed at the lower left hand corner of the filmsheet

- Click to turn on or turn off the Pictorial footer option.

When switched on, the first image of the dataset is shown in the footer of each filmsheet. This function is intended to show a patient identification image aquired with a DXTV camera connected to a DSI system; e.g. a namecard written in a non-Latin alphabet language.

Take care to follow strict procedures in acquiring and printing images using this option.

Section

- Select the number of the section which you want to change

Layout

Rows / Columns

- Enter the number of rows and columns required on the film sheet (or use the + / - buttons to the right of the entry field).

Filling order
The sequence for entering images in the matrix is either by row (horizontally) or by column (vertically).

Start run at
If you have selected several runs and / or images from different datasets for printing, you can determine where each new series of image will start.

- You can select from

– Next free position.
  A new series of images will be printed immediately next to the last image of the previous series of images.
– Next row / column.
  A new series of images will start at a new row / column (depending on the fill order selected).
– New page.
  A new series of images will start at new film sheet, unless there are a number of rows / columns free as set in the free rows / columns field (see below). In that case the new series will start at the next row / column.

Empty rows / columns
When you have set the 'New page' option for printing of a new image series, this may result in large areas of unused film, especially when images series are printed on films with a large number of rows and columns. To avoid waste, the new image series can be printed on the same page as the previous image series when the number of unused rows or columns is at least equal to the number set in the »Empty rows / columns« field.

- Enter the number of free rows / columns (or use the + / - buttons).

Contents

Images printed
You can mark particular Images on the acquisition system as 'Special' before you send them to the EasyVision workstation. An image can be marked on an acquisition system with DSI as 'Special' with the 'large protocol' indicator or on the EasyVision with the 'Special print' option from the image pop-up menu. You can determine which images from an image series must be printed, based on the 'Special' flag. This feature is intended especially for use with protocols with more sections, like this one.

- You can select from
  – All
  – Special only
  – All except special

Skip
When printing large runs or series of images it may be desirable to save film, e.g. when images overlap considerably. To skip a number of images between each printed image:

- Enter the number of images to skip or use the + / - buttons.
  Enter 0 to print all images.

Presentation

Run / image numbers
You can print images with or without run / image numbers:

- Turn on or turn off the »Run / image numbers« option.

Bolus chase print protocol editor

Bolus Chase reconstruction is compatible with DSI and Integris systems. Automatic printing of bolus chase reconstructions is only possible with DSI release 4.x. Figure 1.3 shows the Bolus chase print protocol editor panel.

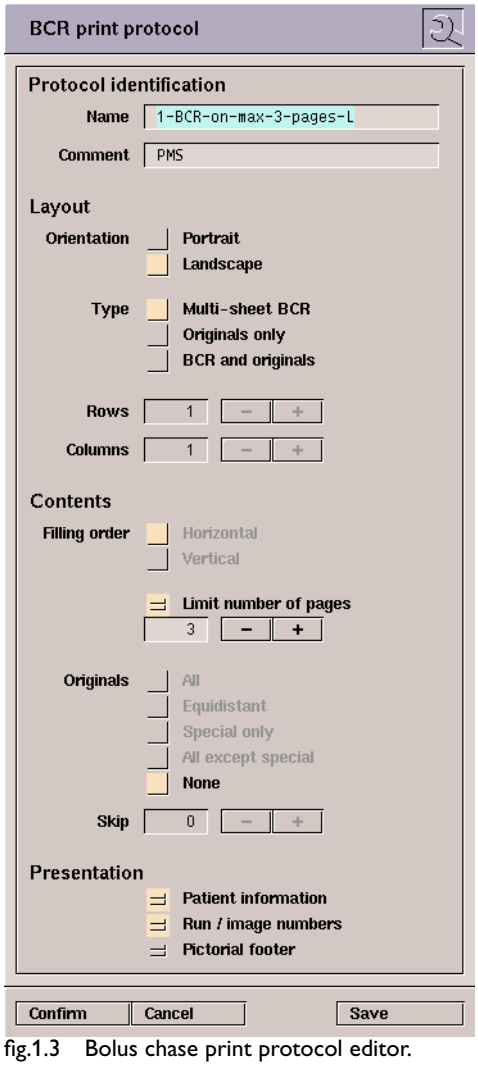


fig.1.3 Bolus chase print protocol editor.

This is the same panel as the Protocol print editor of the Bolus chase application package, except that the »Save« button is not present for customization. (Figure 1.3 shows the editor panel used in the Bolus chase application package).

Print protocol identification

Name / Comment

- Enter a name for the print protocol. This name is used on the »Print protocols customization« and »Automatic printing« panels of the main Customization panel, and in the protocol print function of the application package, as an identifier for selection and editing.
- Enter a comment in the Comment field. This comment is shown in the list of Print protocols on the customization panel.

Layout

Orientation

- Select the orientation of the films that will be produced (portrait or landscape).
  This selection applies to all films printed with the protocol.

Type
There are three types of print protocols for the bolus chase reconstruction package.

- Select from:
  - Multi-sheet BCR
    The bolus chase reconstruction image (BCR) is printed on multiple films.
  - Originals only.
  - BCR and originals

Rows / Columns

- Enter the number of rows and columns required on the film sheet (or use the + / - buttons to the right of the entry field).

Contents

Filling order
The sequence for entering images in the matrix is either by row (horizontally) or by column (vertically).

Limit number of pages
To set the maximum number of films used for printing of a complete bolus chase reconstruction image:

- Enter the number of films to use for a BCR image (or use the + / - buttons).

Originals printed

You can mark particular Images on the acquisition system as 'Special' before you send them to the EasyVision workstation. An image can be marked on an acquisition system with DSI as 'Special' with the 'large protocol' indicator or on EasyVision with the 'Special print' option from the image pop-up menu. You can determine which images from an image series must be printed, based on the 'Special' flag together with the reconstructed bolus chase image.

- You can select from
  - All
  - Equidistant (the images printed are spaced equally in the run)
  - Special only
  - All except special
  - None

Skip
When printing large runs or series of images it may be desirable to save film, e.g. when images overlap considerably. To skip a number of images between each printed image:

- Enter the number of images to skip or use the + / - buttons.
  Enter 0 to print all images.

Presentation

Patient information
To show patient information in the header of each film.

- Turn on or turn off the 'Patient information' option.

Run / image numbers
You can print images with or without run / image numbers:

- Turn on or turn off the Run / image numbers option.

Pictorial footer
For identification purposes, a small image can be printed at the lower left hand corner of the filmsheet

- Click to turn on or turn off the Pictorial footer option.

When switched on, the first image of the dataset is shown in the footer of each filmsheet. This function is intended to show a patient identification image aquired with a DXTV camera connected to a DSI system; e.g. a namecard written in a non-Latin alphabet language.

Take care to follow strict procedures in acquiring and printing images using this option.

Colon print protocol editor

Figure 1.4 shows the Print protocol editor panel for colon reconstruction. The fields on the panel are described below.

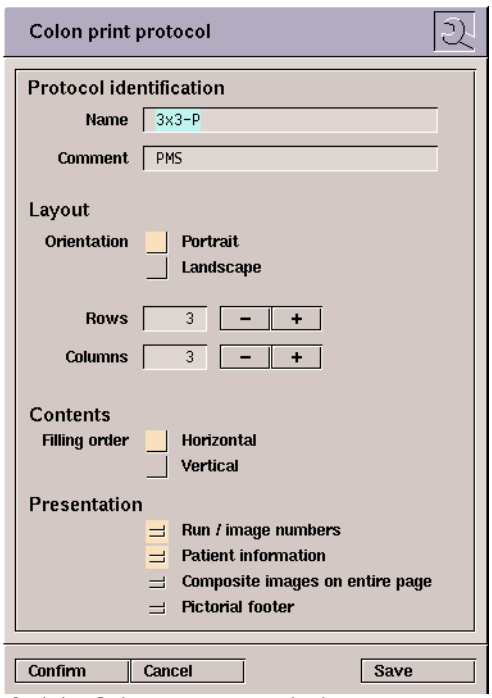


fig.1.4 Colon print protocol editor.

Protocol identification

Name / Comment
Enter a name for the print protocol. This name is used on the »Print protocol« and »Automatic printing« panels of the main Customization panel, and in the protocol print function of the application package, as an identifier for selection and editing.
Enter a comment in the Comment field. This comment is shown in the list of Print protocols on the customization panel.

Layout

Orientation

- Select the orientation of the films that will be produced (portrait or landscape).
  This selection applies to all films printed with the protocol.

Rows / Columns

- Enter the number of rows and columns required on the film sheet (or use the + / - buttons to the right of the entry field).

Contents

Filling order
The sequence for entering images in the matrix is either by row (horizontally) or by column (vertically).

Presentation

Patient information
To show patient information in the header of each film.

- Turn on or turn off the 'Patient information' option.

Run / image numbers
You can print images with or without run / image numbers:

- Turn on or turn off the Run / image numbers option.

Composite images on entire page
You can print the reconstruction on a separate page from that of the individual images, or have all images on the same page.

- Click to highlight the button to allocate a whole page for the reconstruction.
  The individual images are printed on a second page.

Pictorial footer
For identification purposes, a small image can be printed at the lower left hand corner of the filmsheet

- Click to turn on or turn off the Pictorial footer option.

When switched on, the first image of the dataset is shown in the footer of each filmsheet. This function is intended to show a patient identification image aquired with a DXTV camera connected to a DSI system; e.g. a namecard written in a non-Latin alphabet language.

Take care to follow strict procedures in acquiring and printing images using this option.

Spine image print protocol editor

Figure 1.5 shows the Print protocol editor panel for spine reconstruction. The fields on the panel are described below.

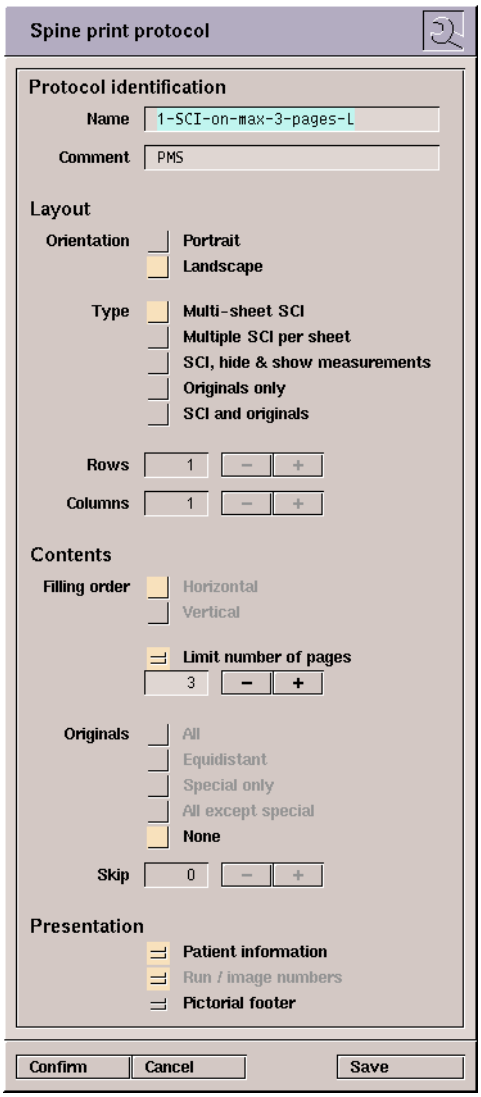


fig.1.5 Spine print protocol editor.

Protocol identification

Name / Comment

- Enter a name for the print protocol. This name is used on the »Print protocols« and »Automatic printing« panels of the main Customization panel, and in the protocol print function of the application package, as an identifier for selection and editing.
- Enter a comment in the Comment field. This comment is shown in the list of Print protocols on the customization panel.

Layout

Orientation

- Select the orientation of the films that will be produced (portrait or landscape).
  This selection applies to all films printed with the protocol.

Type
There are five types of print protocols for the spine reconstruction package.

- Select from:
  - Multi-sheet SCI
    The spine composite (reconstruction) image is printed on multiple films.
  - Multiple SCI per sheet.
  - SCI hide & show measurements.
  - Originals only.
  - SCI and originals.

Rows / Columns

- Enter the number of rows and columns required on the film sheet (or use the + / - buttons to the right of the entry field).

Contents

Filling order
The sequence for entering images in the matrix is either by row (horizontally) or by column (vertically).

Limit number of pages
To set the maximum number of films used for printing of a complete spine reconstruction image:

- Enter the number of films to be used for a Spine Reconstruction image (or use the + / - buttons).

Originals printed

You can mark particular Images on the acquisition system as 'Special' before you send them to the EasyVision workstation. An image can be marked on an acquisition system with DSI as 'Special' with the 'large protocol' indicator or on the EasyVision with the 'Special print' option from the image pop-up menu. You can determine which images from an image series must be printed, based on the 'Special' flag together with the reconstructed spine image.

- You can select from

– All
– Equidistant (the images printed are spaced equally in the run)
– Special only
– All except special
– None

Skip
When printing large runs or series of images it may be desirable to save film, e.g. when images overlap considerably. To skip a number of images between each printed image:

- Enter the number of images to skip or use the + / - buttons.
  Enter 0 to print all images.

Presentation

Patient information
To show patient information in the header of each film.

- Turn on or turn off the 'Patient information' option.

Run / image numbers
You can print images with or without run / image numbers:

- Turn on or turn off the Run / image numbers option.

Pictorial footer
For identification purposes, a small image can be printed at the lower left hand corner of the filmsheet

- Click to turn on or turn off the Pictorial footer option.

When switched on, the first image of the dataset is shown in the footer of each filmsheet. This function is intended to show a patient identification image aquired with a DXTV camera connected to a DSI system; e.g. a namecard written in a non-Latin alphabet language.

Take care to follow strict procedures in acquiring and printing images using this option.

Automatic printing

EasyVision automatic printing uses an alias (recognition code) to link it with an acquisition system. The alias is input with the images from the acquisition system. EasyVision recognizes the code and selects a printer and print protocol for the print request. Printing is then carried out automatically. Automatic printing is available for packages with protocol printing. Acquisition systems able to use automatic printing are DSI, VISUB, Philips CT (HMC) and MR systems. The procedures for setting up links (aliases) for the different acquisition systems are described in the following sections. For each application package, a default print protocol is specified, which is used when an alias is not recognized or absent in the incoming print request.

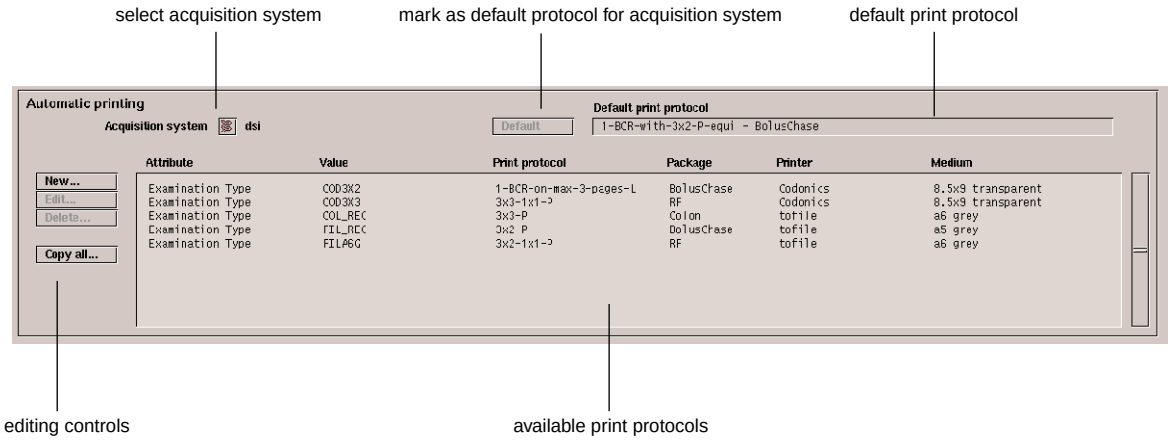


fig.1.6 Print protocol recognition

Default autoprint protocols

When you start a print job from an acquisition console, and if for any reason the auto print protocol is not recognized, a default print protocol is used. A default print protocol can be defined for each connected acquisition system as follows:

- Select the acquisition system from the »Acquisition system« menu.
- Select a print protocol from the »Print protocols« panel.
  Note that a print protocol cannot be selected for the Spine reconstruction package, which does not support auto-print.
- Click the »Default« button.

The default print protocol has been set now, with the protocol name displayed in the »Default print protocol« field.

Auto print recognition with DSI systems.

In this section we describe how to configure your EasyVision workstation for automatic printing from a DSI system. The alias used for automatic background printing with DSI is the parameter “Examination type”.
To prepare for DSI print recognition:

- Make a list of “examination types”, or edit the current list of examination types, in your DSI acquisition system, that you routinely want to print on a predefined layout via EasyVision. These are listed on the »Acquisition default« page, accessed by keyboard function key F6.

Note down the “examination types” literally from the DSI list. Upper and lower case characters are considered as different characters.

examination types

examination type used in the example below

PHILIPS DSI 1994-11-01 13:48:36 Acquisition default F6

exam type	speed	resol.	polarity	gse	subtr.	sub.contr	NR
SWALLW	6/sec	512	invert	L	off	2.5	NR off
BAMEAL	1x	512	invert	L	off	2.5	dyn. low
COLON	1x	512	invert	L	off	2.5	dyn. low
MYELO	1x	1024	normal	L	off	2.5	dyn. med
ARTHRO	1x	1024	invert	L	off	2.5	fix. low
ERCP	1x	1024	normal	C	off	2.5	dyn. med
NEPHRO	1x	1024	normal	C	off	2.5	fix. med
SIALO	1x	1024	invert	L	off	2.5	dyn. med
MCU	1x	512	invert	L	off	2.5	dyn. med
IV DSA	2/sec	512	normal	B	on	5	dyn. med

Add Delete Modify

Make choice with ← and → arrows and press ↵ ENTER

fig.1.7 DSI examination type screen

The examination type as displayed on the DSI monitor is used as the alias. For reconstructions, the examination type is appended with _REC as the »Value« as the protocol recognition.

Note that for DSI software, releases 4.3 and earlier, only Bolus chase reconstructions are possible, and are flagged at the console.

For DSI software release 4.4, spine, colon and Bolus chase reconstructions are flagged at the console.

Example:

- The DSI examination type is “COLON”
- User flags the examination as a reconstruction.
- “COLON_REC” is the alias (»Value«) used to link the DSI to the EasyVision protocol used for printing the images.

Keep your list of aliases for reference and proceed to section ‘Linking protocol recognition codes’ on page 1-22.

Auto print recognition with VISUB systems.

In this section we describe how to configure your EasyVision workstation for automatic printing from an Integris system. The alias used for automatic background printing with an Integris system is the parameter “Physician code”.
Make a list of physician codes, or edit the current list of codes, in the VISUB display of your Integris system, that you routinely want to print on a predefined layout via EasyVision. These are listed on the »Network« page, accessed by keyboard function key F5, and on the »Physician« page, accessed by button F7.

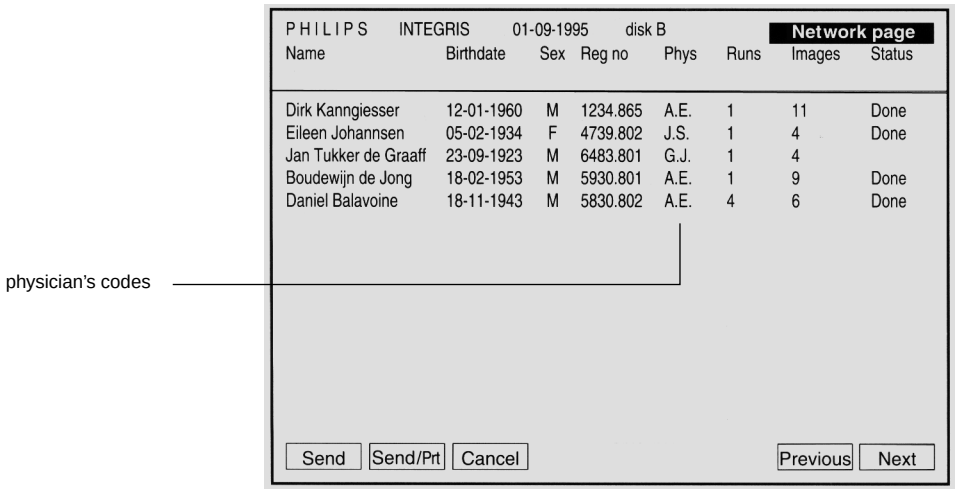

PHILIPS INTEGRIS 01-09-1995 disk B
Network page
Name Birthdate Sex Reg no Phys Runs Images Status
Dirk Kanngiesser 12-01-1960 M 1234.865 A.E. 1 11 Done
Eileen Johannsen 05-02-1934 F 4739.802 J.S. 1 4 Done
Jan Tukker de Graaff 23-09-1923 M 6483.801 G.J. 1 4
Boudewijn de Jong 18-02-1953 M 5930.801 A.E. 1 9 Done
Daniel Balavoine 18-11-1943 M 5830.802 A.E. 4 6 Done
physician’s codes
Send
Send/Prt
Cancel
Previous
Next

fig.1.8 VISUB network page

Keep your list of codes for reference and proceed to the next section ‘Linking protocol recognition codes’ on page 1-22.

Linking protocol recognition codes

The alias used to link workstation and acquisition system is defined on either system and recognized by EasyVision, i.e. it can be defined on either the customization panel of the EasyVision workstation, or as one of the parameters of the acquisition system.
In this section it is assumed that the alias is defined at the acquisition system for DSI and VISUB systems, and on the EasyVision customization screen for CT and MR systems.
For DSI and VISUB systems, once you have established the aliases which are to be sent with the print jobs from the acquisition system, you can link them to a particular print protocol with the Automatic printing protocol recognition editor.
For CT and MR acquisition systems, the alias is likely to be defined on the customization screen, and then used on the acquisition system when sending print requests.

Adding a new link

To link a protocol recognition code to a print protocol:

Begin

- Select the acquisition system from the »Acquisition system« menu on the »Automatic printing« panel.
- Select the application from the »Application package« menu on the »Print protocols« panel.
  A list of protocols for the selected package is displayed.
- Highlight the desired protocol.
- Click the »New...« button on the »Automatic printing« panel.
  The »Automatic printing: protocol recognition« panel is displayed, with the selected protocol.

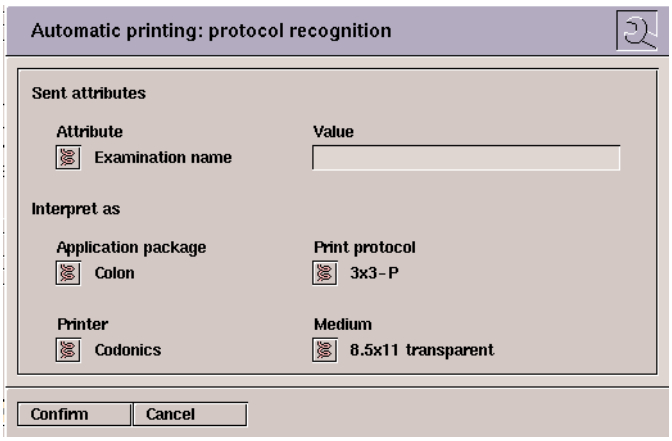


fig.1.9 Print protocol recognition editor

- Select the »Attribute« for the acquisition system.
  The options available are as follows:
  – For DSI systems, »Examination type« is always used.

  - For VISUB systems, »Physician name« is always used.
  - For Philips CT (HMC) systems, select either »Scan protocol« (for scan
  - level image input) or »Requester« (for examination level image input).
  - For Philips MR systems, select either »Examination name« (for examination level image input) or »Workstation protocol« (for scan level image input).

- In the »Value« text entry field, enter the alias.
  Aliases have been explained in the previous sections. For DSI reconstructions append "_REC"; e.g. COLON_BC would be the »Value« for the DSI example, described earlier.
  For DSI and VISUB systems, these codes are obtained from the acquisition system. For CT/MR systems, these codes are defined here on the »Automatic printing: protocol recognition« panel, and are entered on the console of the acquisition system (as described earlier) each time that images are received by EasyVision for printing.

The remaining parameters are entered from pop-up menus displayed by select buttons.

- Select the Application package. The choice is restricted to those which support protocol print (i.e. not those which use Screen print):
  - Bolus Chase (for DSI systems)
  - Cardio
  - Colon (for DSI systems)
  - RF viewing
- Select the print protocol.
  The pop-up menu lists the available protocols for the selected application package.
- Select a printer.
  The pop-up menu lists the printers connected to the workstation.
- Select a print medium.

The pop-up panel lists the media supported by the selected printer.

- Click the »Confirm« button to store these values.

The »Automatic printing: protocol recognition« panel disappears and the protocol with the entered parameters appears as the default print protocols in the »Automatic printing« panel.

End

Modifying and removing links

You can also modify and remove print recognition links:
To change a protocol recognition link:

Begin

- Select from the recognition code selection list the link which you want to modify.
- Click the »Edit...« button.
  The »Automatic printing: protocol recognition« panel (Figure 1.9) is displayed.
- Enter the protocol recognition code and select the print protocol as with a new link.
- Click the »Confirm« button.
  The editor panel disappears and the link that you selected is updated in the recognition code selection list.

End

To remove a print recognition link:

- Select from the recognition code selection list the link which you want to remove.
- Click the »Delete...« button.
  The link that you selected is removed from the recognition code selection list

Copying links

To transfer all aliases of an acquisition system to all others of the same type.

This is only possible if there are at least two acquisition systems of the same type connected to the workspot, indicated by the »Copy all...« button set in its active state.

- Click the »Acquisition system« button and select the source system for the aliases.
- Click the »Copy all...« button.
  The »Copy all aliases« panel is displayed, with the (source) text field showing the selected source acquisition system.

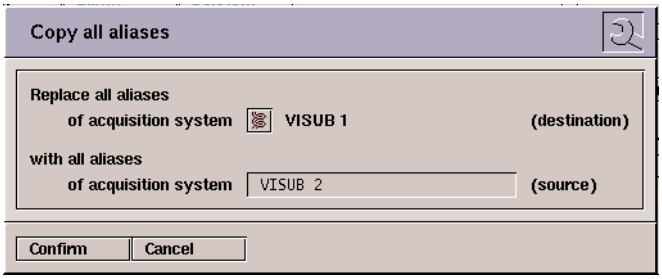


fig.1.10 Copy all aliases panel

- Click the »Replace all aliases of acquisition system« button and select the destination system (the system to have the same aliases as the source acquisition system).
- Click the »Confirm« button.
  The aliases are copied from the source acquisition system to the destination acquisition system and the »Copy all aliases« panel is removed. The protocols on the »Automatic printing« panel now list the same aliases for both acquisition systems.

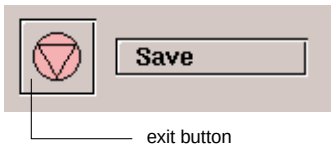
Save and exit

After you have finished customizing database, autorouting and print protocols, you can leave the configuration program.

Do not forget to save the definitions that you made.

To finish your customizing:

- Click the »Save« button.



- Click the exit button.

  You are prompted to confirm before the program exits.

After the program exits, the system start-up menu is displayed on the screen. Your EasyVision workstation is now set up. You may alter the settings when, for example, new protocols or users are to be added, by re-entering customization mode and editing the default values already present. Start by clicking the »Add defaults« button to bring up the parameters already entered, and to enable editing.

Chapter 2
Standard functions

Image selector

The image selector is used to select images for viewing on an image-by-image basis. It shows the images of the examinations that you have chosen from the examination selection list. When there are too many images to display in the pictorial selector then use the scroll buttons to the right of the display area to view the off-screen images.

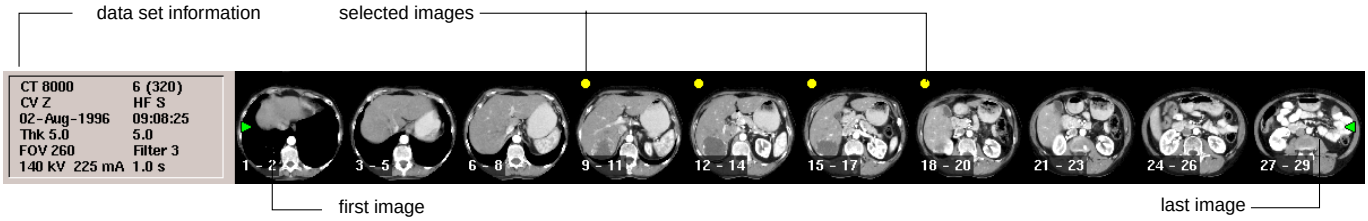


fig.2.11 Pictorial selector row.

The first and last image of a scan or series of images are marked with small green triangles, the images that you have selected are marked with yellow dots. The image number is shown in the lower left hand corner of each image. A small information panel to the left of the first image shows data set information about the images displayed.

Dataset information panel

The information displayed in the text panel depends on the dataset. An overview is given of the data elements displayed for each imaging modality. To the left an example for a modality is given, to the right a description of the data element types is listed.

RF images:

RF Run 2	**32 images**
myelo	
	1024 x 1024

Modality / Run number [a]	No. of images in run
Examination type	
	Scan pixel matrix size
Peak voltage	Exposure (current)

a. Reconstructions may have BCR, SCI or CCI appended.

Database controls

The top left part of the pictorial select tool panel shows the following database controls:

fig.2.12 Database select controls.

To reduce the contents of the examination list with the database query function:

- Click the database query button.
  The database query panel is displayed. See section 'Database query' on page 31 about how to apply a database query. Once you have applied a query, the database query option remains active.

To reset the database query
without going to the database query panel:

- Click the database query option.

Image selection controls

The pictorial selector may show all the images from the data sets that you have selected from the examination selection list or show an overview of the selected data sets.

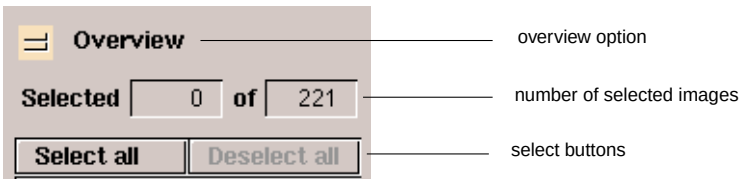


fig.2.13 Image select controls.

To show all images of a data set:

- Click the »Overview« option to remove the highlight.
  Each data set starts at a new row, all images are shown and the information panel at the beginning of the data set shows the parameters of the data set.

To show a data set overview:

- Turn on the overview option.
  If the number of images in a data set is too large to fit in a row, then images are removed at regular intervals to enable the images that represent the data set to fit in a row. In this case a single image represents a sequence of images, with the image numbers displayed in the lower left hand corner. When you click on such an image in the pictorial selector, all the images indicated by the range numbers are selected for viewing.
  A number of consecutive small data sets is displayed together in a row if they fit into a row. In this case the information panel shows only the parameters common to all images in the row.

Image selection procedure

The procedure for selection of images for display on the main panel of the application package is as follows:

Begin

- Click the required examination on the »Pictorial select« panel.
  The picture area of the panel displays a selection of the complete examination images.
- Select the images for display on the main panel of the application package.
  These are indicated by yellow dots, with the total number of selected images indicated by on the control panel. Different ways of image selection are described in the section Selection options.
- Click on the »Confirm« button to remove the »Pictorial select« panel and return to the main panel of the application package.
  The selected pictures are displayed in the default format, which can be modified.

End

The way the images are shown and how you can navigate through the selected images depends on the viewing package from which you activated the patient examination select tool.

Selection options

When the Pictorial select panel is displayed, images can be selected or de-selected from a complete examination, using the following procedures.

To select a complete examination:

Begin

- Select the examination that you want to view in the examination selection list.
  The pictorial selector is filled with images from the selected examination.
- Click the »Select all« button.
- Click the »Confirm« button.
  - or -
- Double click the examination that you want to view in the examination selection list.
  All the data sets within the examination that you have chosen are selected for viewing. The pictorial selection tool panel disappears from the screen and the images of the first data set are shown in the image display area.

End

To select only a part of an examination or a data set

Begin

Pictures can be selected singly or in groups, using the following procedures.
Selection of single images

- Click on a **not selected** image to add it to a selection.
- Click on a **selected** image to remove it from a selection.

Selection of a number of adjacent images:

- To add images to a selection, drag over the images starting with a **not selected** image.
- To remove images from a selection, drag over the images starting with a **selected** image.

Selection of a run or series of images

- To add a series of images to a selection, double click on one of the not selected images (do **not** double click the **first** image).

A double click on the **first** not selected image of an image series will select the whole series and de-select all other image series. The pictorial select tool panel is removed and the selected series is displayed in the image display area.

- To remove a series of images from a selection, double click on one of the selected images.

Selection of all images

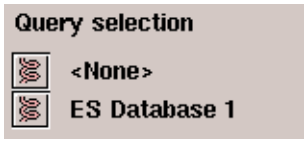
- To include all images in the selection, click the »Select all« button.

End

- To remove all images from a selection, click the »Deselect all« button.

Database query

Two query select buttons are provided for database queries.



– The lower button accesses the databases connected to the system. The database currently accessed is shown alongside the button, and its list of examinations is shown at the top of the Picture select panel. The default database is the local database.

– The upper button allows selection of examinations from the currently accessed database, using user criteria. This limits the list of examinations shown on the Picture select panel to those which satisfy the criteria. Criteria are entered on a query panel, and may be saved for recall at a later date.

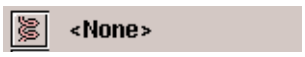
To set-up or modify queries:

Begin

First select a database:

- Right click the lower button to display the pop-up panel with the available databases
- Move the cursor over the required database.
  The database is highlighted.
- Click the database.
  The pop-up panel disappears, the selected database name appears beside the select button, and the examinations in the database are displayed.
  - or -
- Left click the lower button repeatedly until the label of the required database appears to the right of the select button.

Now use the »Query« panel to set-up or modify queries:



- Left or right click on the upper button and select the »User definition« option to display the »Query« panel.

End

- Then follow the procedures.

Select examination

Three of the application packages, Volume, Perfusion and CT/MR cardiac display a Select Examination panel without pictorial selection when the Patient examination select button is clicked. This is similar to the Data Handling screen.

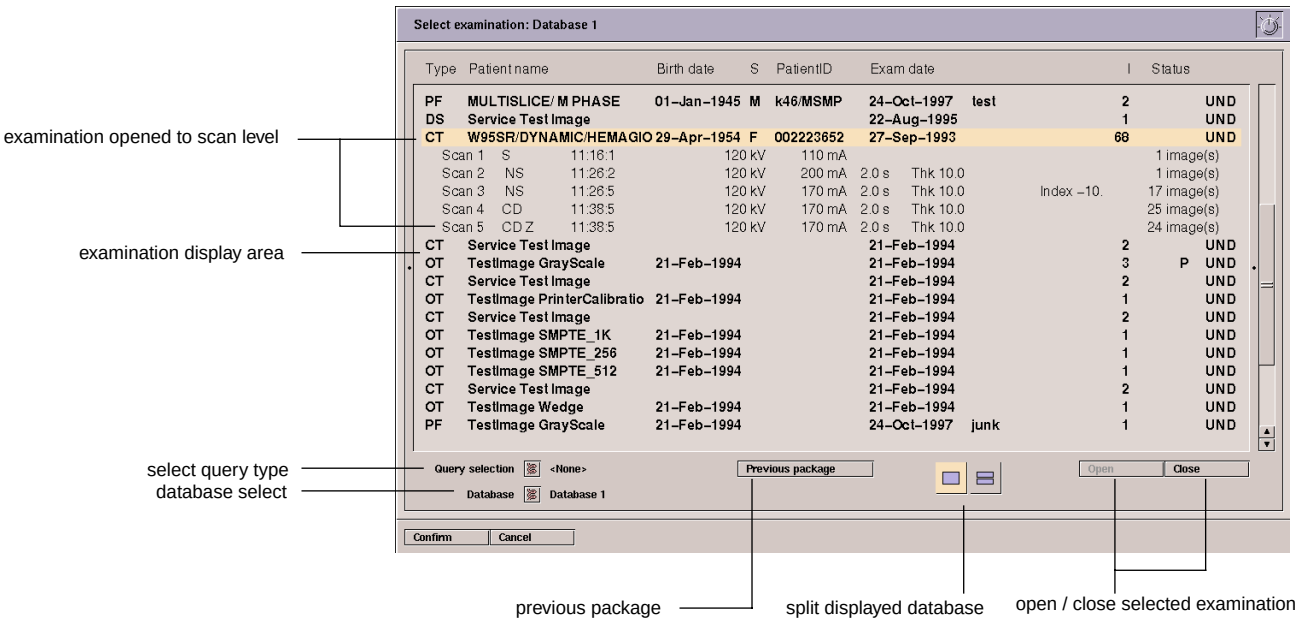

examination opened to scan level
examination display area
select query type
database select
previous package
split displayed database
open / close selected examination
Select examination: Database 1
Type Patient name Birth date S PatientID Exam date I Status
PF MULTISLICE/ M PHASE 01-Jan-1945 M k46/MSMP 24-Oct-1997 test 2 UND
DS Service Test Image 22-Aug-1995 1 UND
CT W95SR/DYNAMIC/HEMAGIO 29-Apr-1954 F 002223652 27-Sep-1993 68 UND
Scan 1 S 11:16:1 120 kV 110 mA 1 image(s)
Scan 2 NS 11:26:2 120 kV 200 mA 2.0 s Thk 10.0 1 image(s)
Scan 3 NS 11:26:5 120 kV 170 mA 2.0 s Thk 10.0 Index -10. 17 image(s)
Scan 4 CD 11:38:5 120 kV 170 mA 2.0 s Thk 10.0 25 image(s)
Scan 5 CD Z 11:38:5 120 kV 170 mA 2.0 s Thk 10.0 24 image(s)
CT Service Test Image 21-Feb-1994 2 UND
OT TestImage GrayScale 21-Feb-1994 21-Feb-1994 3 P UND
CT Service Test Image 21-Feb-1994 2 UND
OT TestImage PrinterCalibratio 21-Feb-1994 21-Feb-1994 1 UND
CT Service Test Image 21-Feb-1994 2 UND
OT TestImage SMPTE_1K 21-Feb-1994 21-Feb-1994 1 UND
OT TestImage SMPTE_256 21-Feb-1994 21-Feb-1994 1 UND
OT TestImage SMPTE_512 21-Feb-1994 21-Feb-1994 1 UND
CT Service Test Image 21-Feb-1994 2 UND
OT TestImage Wedge 21-Feb-1994 21-Feb-1994 1 UND
PF TestImage GrayScale 21-Feb-1994 24-Oct-1997 junk 1 UND
Query selection <None>
Database Database 1
Previous package
Open
Close
Confirm
Cancel

fig.2.14 Selection examination panel

The open / close and query buttons activate functions similar way to the those in the Data handling package, except that patient folders can only be opened to one subsidiary level (scan level). The split button allows two displays of the database listing, which are separately scrolled.

Image selection procedure

This procedure uses two select buttons, for database and query criteria, in a similar way as the Picture selection tool, to select patient examinations.

Begin

To select the required database

- Repeatedly left click on the »Database« select button, until the required database label appears to the right of the button. The examinations in the database are listed in the examination display area.
  -or-
- Right click and hold the »Database« select button to view the pop-up panel with the list of databases available. Move the cursor on to the required database and release the mouse button.
  The pop-up panel disappears, the label of the selected database appears to the right of the button and the examinations in the database are displayed.

To select examinations by criteria, or to select particular examinations in large databases.

- Use the scroll bar and buttons to view off-screen examinations in the database.
- Click on the required examination to select. The selection is highlighted.

Query selection

- Right click on the »Query selection« button.
  A list of available criteria is displayed.
- Click on the required criteria.

  - or -

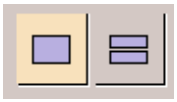
- If no criteria are satisfactory, click on the »User definition« option.
  The Query panel, used in the Data handling package, is displayed, and user-defined criteria may be entered, as described in Data handling.

To select individual runs of a selected examination

- Click on the »Open« button.
  The examination is divided into individual scans, with scan information. The more detailed lower level information is presented on separate lines, indented, and each line is individually selectable. Several lines may be selected by clicking with the middle mouse button.
  Clicking on the »Close« button of the upper level, removes the lower level from the display.

Note that there are only two levels of examination information. This contrasts with the Data handling package, which has five levels.

- Clicking on the »Previous package« button returns to the last application package opened. This allows examination selections to be shared between two packages.



- Clicking on the »Split« button splits the patient listing into an upper and lower half, each with its own set of scrolling buttons. Clicking on the merge button reconfigures the screen as a single listing
- When the images for display have been selected, click on the »Confirm« button.
  The »Select examination« panel is removed, and the selected images are displayed on the main panel of the application package.

End

Compose review folder

This function allows patient images to be selectively assembled in a folder for examination. Images are selected and assembled from those available in the list of examinations in the database. The folder is given an identifying name, and can then be distributed or stored The folder appears on the selection list and is classed as OT (other).

Creating and modifying folders

To make a new folder

Begin

- On the application package screen, select the patient examination for display.

- Click on the Compose photo folder button.
  The »Compose photo folder« panel is displayed.

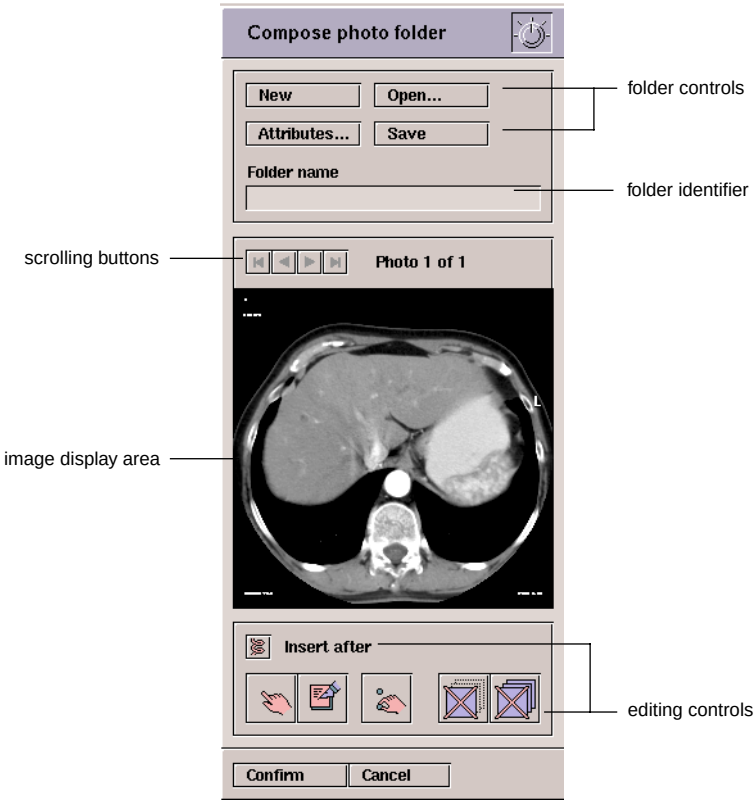


fig.2.15 Compose photo folder panel

- Click on the »New« button
  The panel fields are cleared, ready for new input, The page number defaults to »Page 1 of 1«, and the insert button to »Insert after«.

- Activate the select image button by clicking on it.
  The cursor changes to the select arrow, allowing image selection. .

- Click an image on the main display for the first page of the folder.
  The image is copied to the display area of the Compose photo folder.
- Click on images to add to the folder.
  After each click, the image is shown in the display area. The page number increments, showing that new images are added to the end of the folder (if the default »Insert after« order selection has not been changed).
- When the folder is complete, de-activate the select image button by clicking on it and enter an identifier in the folder name field.
- Use the buttons as described in the section 'Editing a folder' on page 37 to add folder properties.
- Click on the »Save« button.
  The new folder is placed in the currently accessed database under its folder name.

End

To modify an existing folder

Begin

- Open the database containing the folder to be modified.

- Click on the Compose photo folder button to display the »Compose photo folder« panel.
- Click on the »Open« button.
  The list of available folders is displayed on the Select photo folder panel.

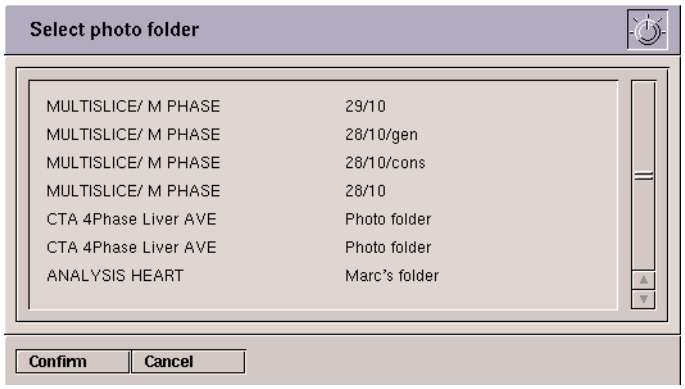


fig.2.16 Select photo folder

- Double click on the folder to be modified.
  The first page of the selected folder is displayed on the Compose photo folder.
- Modify the folder, as described in the properties section below.
- Click on the »Save« button.
  The modified folder will overwrite the original in the database.

End

Properties of folders

The properties and fields on the »Compose photo folder« screen are detailed below can be used for making or modifying a photo folder.

Folder control

– »New«
Clears the Compose photo folder panel to enable a new folder to be set up.

– »Open«
Displays a list of available folders, in the currently accessed database, on the pop-up Select photo folder panel.
Clicking on a selected folder transfers the folder to the Compose photo folder panel.

– »Attributes«
Clicking on this button displays the »Document attributes« panel, shown below.

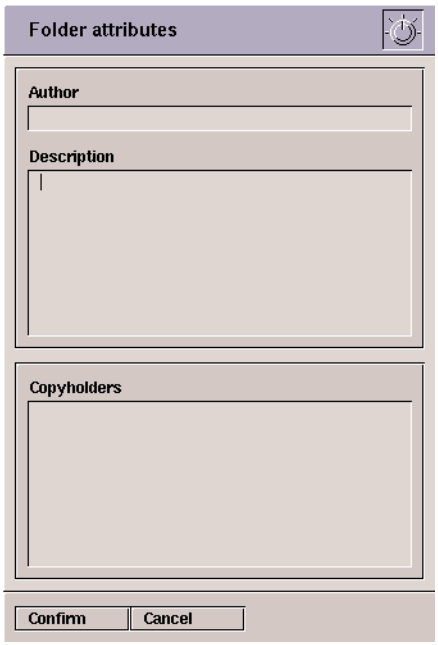


fig.2.17 Document attributes panel

Text may be added or edited by clicking the cursor in a field and using the cursor control keys of the keyboard. Attributes are stored in the folder and can be called up when the folder is open.

– »Save«
Clicking this button stores the new or modified photo folder in the currently accessed database. A modified file with unchanged folder name overwrites the original.

Editing a folder

The following buttons on the Compose photo folder are used to edit the folder.

– Scrolling buttons

These buttons are used to access a particular image by paging forward or backward through the folder.

– Insert button

Clicking on this button toggles between »Insert before« and »Insert after«. This enables extra images or text pages to be inserted.

– Image entry mode.

When active, images may be entered in the folder. This is indicated by the cursor changing to the select arrow.

– Image comment.

Clicking on this button displays the »Image commentary« panel. Text can be typed in the panel. The font button allows three text sizes to be selected.

Clicking the »Confirm« button transfers this text to a separate page in the folder, defined by the setting of the scrolling and insert buttons.

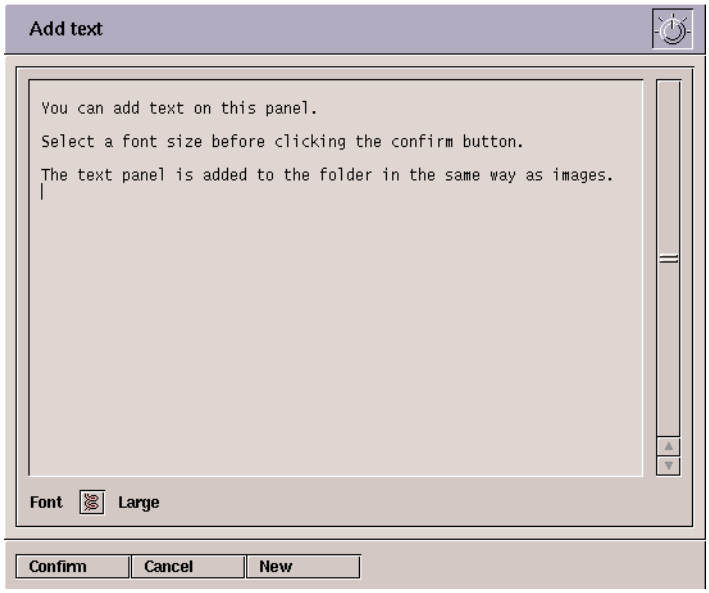
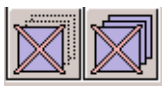

Add text
You can add text on this panel.
Select a font size before clicking the confirm button.
The text panel is added to the folder in the same way as images.
Font
Large
Confirm
Cancel
New

fig.2.18 Folder image commentary panel.

– Control button

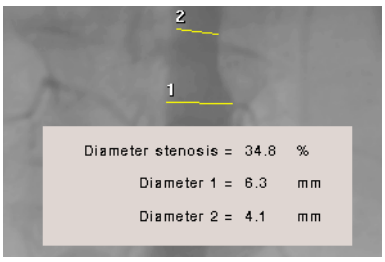
Clicking this button displays the Photo attributes panel. Colour may be selected or disabled, and the picture size set to 1024 x 1024 or 512 x 512 pixels.



– Delete image buttons

Clicking on these deletes images from the folder. Images are deleted either from the currently displayed page, or all images from the complete folder.

Vessel diameter measurements



The vessel diameter measurement tool allows to measure two vessel diameters. For a stenosis you have to measure the diameter at a stenotic location and a nearby normal diameter. The results are displayed on the image:

– Both diameters, in mm if the image is calibrated.

– The difference in the two diameters, expressed as a percentage of the larger diameter.

Procedure to enter a vessel diameter

Begin To determine vessel diameters and stenosis

• Click the vessel measurement button.
The »Vessel diameter« panel is displayed:

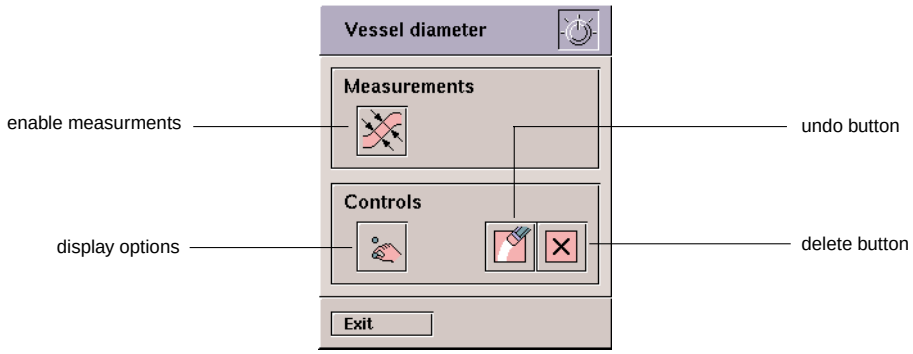


fig.2.19 Vessel diameter panel

• Use the Zoom tool to enlarge the image to display the vessel segment that you want to measure.

The measurements are more accurate at enlargements which show the stenosis in sufficient detail.

• Click on the Measurements button. The cursor changes to a cross-hair.
Indicate the diameter at the location of the stenosis and a reference diameter, it does not matter which of the two you enter first.

• Click two points at the first diameter that you want to measure.

• Click two points at the second diameter that you want to measure.
When you have entered both diameters, the display zooms to show only the region of interest with the annotated diameters.

• On the enlarged area you may fine tune the measurements as described in the next section.

Editing vessel diameters

To correct a diameter:

- Drag the diameter line at its handles, its line or at its label.

To delete the last operation:

- Click the Undo button.

To remove a vessel diameter measurement from the display:

- Select one of the diameters to be deleted, by clicking on it.

- Click the Delete button.

To select line properties:

- Click the controls button.

  The »Display options« pop-up panel appears, to allow selection of line colour and width.

- Click »Confirm« to set these properties on the display image and return to the »Vessel diameter« panel.

End

- Click the »Exit« button to return to the main panel of the application.

  The vessel diameters entered are retained and displayed on the main panel image.

Movie tool

The movie function is used to:

– browse through a volume or series of images.

– display a series of images as a movie.

To activate the movie function

- Click the movie button.
  The »Movie« control panel is displayed. 2.20 shows the panel layout used for X-ray packages. Stack viewing has a movie tool which functions in a similar way, but has a different panel layout. The movie button in volume visualisation uses a different method to generate sequences. Refer to the chapter, 'Volume visualisation'.

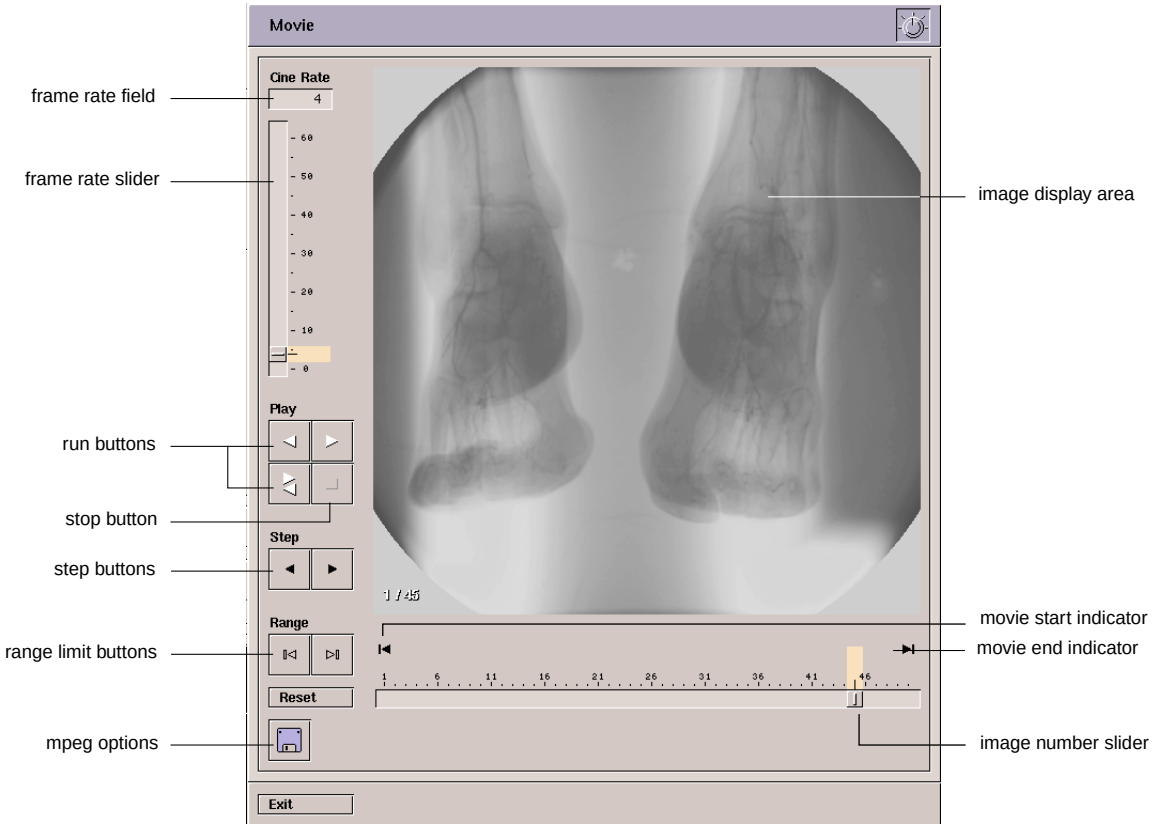


fig.2.20 Movie control panel

Scanning through a sequence of images

To browse through a volume view or a sequence of images:

Begin

- Drag the image number slider.
  - or -
- Click one of the step buttons.
  - or -
- Press and hold down one of the step buttons.

To display a particular image:

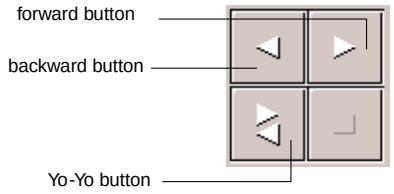
- Click in the image number slider at the number of the image that you want to display.

End

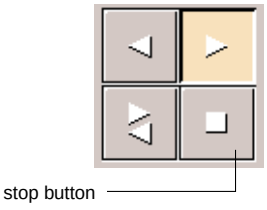
Movie display

To run a movie display:

Begin



- Click one of the movie run buttons.
  The movie display runs according to the button clicked.
  - forward:
    The movie display runs continuously from the lower to upper limit as specified by the range limit buttons.
  - backward:
    The movie display runs continuously from the upper to lower range limit.
  - Yo-Yo:
    The movie display runs alternately forwards and backwards between the upper and lower range limits.



- Click the movie stop button to stop the movie display.

To set the movie range limits:

- Scroll to an image where you want to start or end the movie display.
- Click the lower or upper limit button respectively.
  The movie range limit markers are adjusted to the limits that you have set.

End

To set the movie display speed:

Begin

- Adjust the frame rate slider.
  - or -
- Enter the frame rate in the frame rate field.
  The movie display runs at approximately the adjusted rate. It is possible that the higher frame rates is not reached. This depends on the number of images that you have selected for movie display and the memory resources that you have.

End

Chapter 3
R/F Viewing

Introduction

The EasyVision R/F viewing package is a versatile package designed for viewing of images produced by digital X-ray systems.

Images can be selected for viewing from the database with the Pictorial select tool. Within this function sub-selections can be made from the pictorial overview. The query function can be used to limit the number of examinations presented.

The patient orientation is defined conform to ACR NEMA standards. The orientation of the images is similar to the acquisition system orientation.

Image import

Integris H and V systems

Images from Integris H and V systems are transferred to EasyVision as raw data. Integris V system images are processed by EasyVision during import whereas Integris H system images must be imported as raw data to allow cardiac analysis. Individual runs and / or images can be 'flagged' on the Integris H or V console for transfer to EasyVision.

- When individual images from a subtraction run are to be sent to EasyVision, the mask image must also be flagged in order to enable EasyVision to execute the subtraction during processing on import.

- When Contrast / Brightness adjustments are made on the Integris H or V console, the changes must be 'saved' on the Integris H and V system for transfer of these settings to EasyVision. Settings are saved by accessing the database, i.e. by selecting another examination / run for viewing.

- Before import from an optical disk (from Integris H and V systems) processing can be switched off using the corresponding retrieve option ('as is', 'as vascular' or 'as cardio') on the Database Information panel of the optical disk in the data handling application.

CT and MR systems

CT and MR images can be viewed in the EasyVision R/F viewing package, but the CT/MR orientation indicators for Left, Right, Anterior and Posterior will not be displayed on screen or film.

This chapter explains how to select examinations and view images and describes the basic view functions.

X-Ray Viewing

To select the R/F viewing package:

- Click the R/F viewing button on the package switch panel

The workstation screen shows the layout for the R/F viewing package:

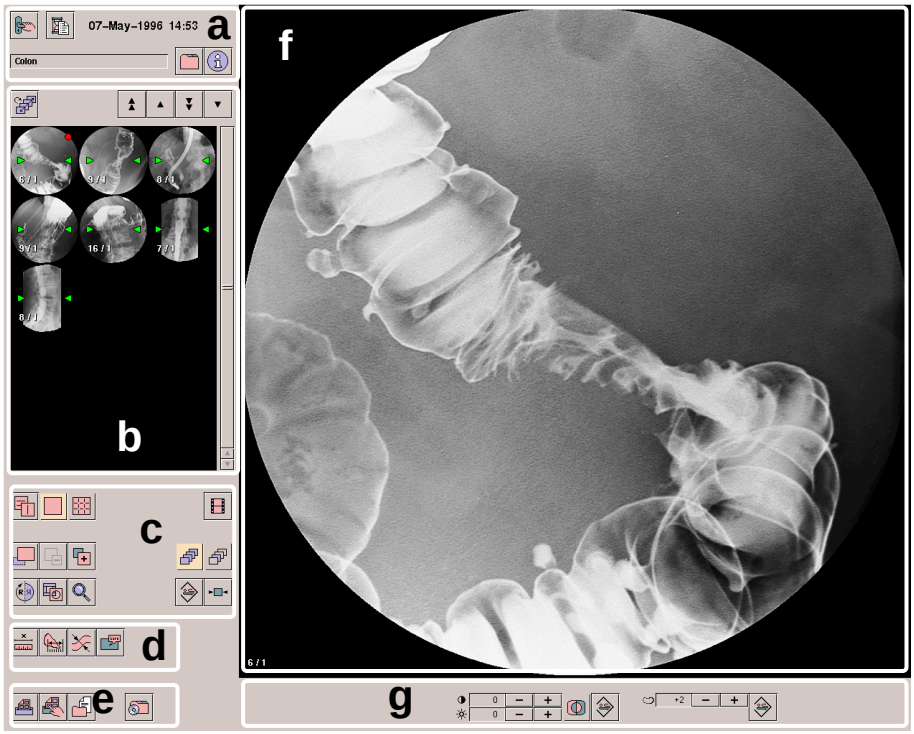


fig.3.1 X-Ray Viewing screen

Main screen	Area	Remarks
a	General controls	General workstation controls and examination selection
b	Pictorial index	Shows the images in the selected examination, and controls to browse through these images.
c	Viewing controls	Viewing controls for image presentation
d	Analysis controls	Measurement and annotation controls.
e	Documentation controls	Print and review folder controls, data handling short-cuts
f	Image area	Shows one or more selected images
g	Image presentation controls	To change contrast, brightness and image sharpening

General controls

– Package switch

To switch from one package to another and to EXIT the EasyVision system.

– Workstation status

To display status information on the background process (print, store and communication).

– Pictorial Select

To select examinations for display.

– Image information

To display information about the image.

Image selection

– Reorder

To change the order of the selected images.

– Previous / next row or screen

To display previous / next row or screen of selected images.

– Pictorial index

To browse through the images and to select an image for viewing.

Viewing controls

– 1x1 image layout

To display a single image in the image area.

– 3x3 image layout

To display 3x3 images in the image area.

– Alternative layouts

To select an alternative layout for the image area.

– Movie

To view the selected images as a movie.

– Zoom *

To zoom images via a control panel.

– Zoom out

To reduce the magnification of the displayed images with a fixed factor.

– Zoom in

To enlarge the magnification of the displayed images with a fixed factor.

– Rotate / Mirror *

To rotate and mirror images on screen.

– Shutters *

To shutter part of the image in order to focus on specific features: horizontal, vertical and circular shutters can be selected.

– Magnifying glass *

To magnify a part of an image using a magnifying window.

– Run processing

To apply processing functions such as zoom and contrast / brightness adjustment to all images in the run currently displayed on the screen.

– Screen processing

To apply processing functions such as zoom and contrast / brightness adjustment to the displayed images only.

– Reset View

To reset all viewing parameters such as zoom and contrast / brightness adjustment.

– Reset all

To reset all viewing parameters such as zoom and contrast / brightness adjustment, and to reset the screen layout.

The functions marked with an asterix (*) are treated in detatil in Chapter 5, ‘Standard functions’.

Analysis controls

– Calibration
To calibrate measurements using image structures of known size.

– Measurements
To measure distances, angles and areas on images.

– Vessel diameter
Measure two vessel diameters. Percentage difference is given.

– Text annotation
To annotate images with arrows and text.

Documentation controls

– Protocol Print
To print in according to the current protocol.

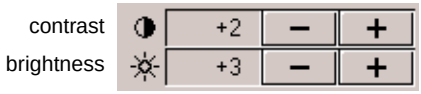
– Print Compose
To compose a print sheet in a format other than that specified by the current protocol.

See also See... about how to print images on film.

– Compose review folder *
To compose manually a collection of images and comments for later review.

– Data handling short-cuts
To copy, store on optical disk and to remove images without switching to the data handling package.

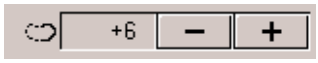
Image presentation controls



– Image contrast and brightness
Increase / decrease contrast and brightness.

– Image invert
To invert the grey level scale for image display

– Reset contrast, brightness and grey scale invert.
To resets contrast, brightness and grey scale invert to settings as applied at data acquisition.



– Edge enhancement
Increase / decrease edge enhancement.

– Reset edge enhancement.
Resets edge enhancement to settings as applied at data acquisition.

Image area

The image area displays a number of images and from the selected examinations. The images are labelled with the following information:

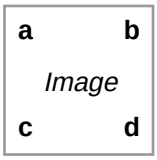
– Patient name (only if the selection contains examinations of different patients)

– Run / image numbers

– Orientation

– Quality indicators

The format for image labelling is as follows:



Item	Information	RF, DS, DR image
a	Patient	Patient name
b	Quality indicator	<C2,!> [a]
c	Image identification	Run number / image number [b]
d	Image orientation	Rot./Ref. pictogram [c]

a. The image quality indicator(s) are displayed in brackets (<>) and give the following information concerning image quality:
C : Compression with loss of information, factor >2
S : Survey image
! : Limited reliability
I : Inconsistent information
F : Fluoroscopy (low resolution)

b. If subtracted image:run number / image number - mask image number
If mask image:run number / image number -
If photo image:[P] image number / 1

c. Relative orientation (rotate/mirror) pictogram:

H = flip left / right; V = flip up / down; 90 / 180 = ± 90°

See also Chapter 5, ‘Standard functions ’Rotate/Mirror tool.

Selecting images from the database

Examinations and images can be retrieved from the database using the pictorial select tool.

To start the pictorial select tool:

- Click the pictorial select button.

For a detailed description about how to use the pictorial select tool, see Chapter 5, 'Standard functions'.

Once you have selected images from the database, these images will be shown in the pictorial index on the main screen. If not all images can be shown in the pictorial index, you can browse through the images before you select them for viewing in the main image area.

Pictorial index

The pictorial index shows the image content of the selected examinations and can be used to select the image to be viewed.

fig.3.2 Pictorial index

The reduced images are displayed in 3 x 5 matrix. Series of images are marked with a green triangle at the left side of the first image and at the right side of the last image. A single image shows both green markers.

When the selected examination(s) contain more images than can be fitted in the pictorial index, a scrollbar to the right of the pictorial index can be used to browse through all images available for viewing.

The Pictorial index can be used to select images for viewing. Once an image or images have been selected, a red dot is displayed at the top right hand corner of the index image and the image(s) appear in the image area.

Selecting images for viewing

Images that you want to show in the image display area in the main screen can be selected with the pictorial index or with the image step buttons.

Selecting with the pictorial index

Begin

If the image that you want to select for viewing is not visible in the pictorial index:

- Drag the scroll bar to show the desired image in the index panel.
- Click the image that you want to display.

The selected image appears in the image area. If the layout of the image area shows more than one image, the selected image is shown as the first image at the top left hand corner of the image area.

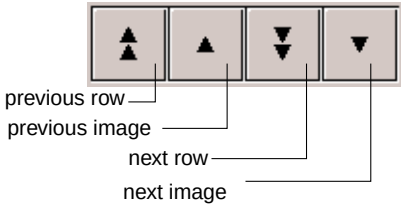
End

Selecting with the step buttons

With the image step buttons you can step forward or backward through the images available for viewing. With the previous / next image buttons you can step on image at a time. If the image area layout shows two or more rows of images, then you can step a row of images at a time.

To step through the images:

- Click the appropriate image step button.



Note that there is no difference in using the step image button or step row button when the image area is set to the single image layout.

Viewing images

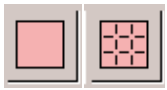
The viewing controls of the R/F Viewing package are described below. With these controls you can change the image display layout, image ordering and select images for display in the image display area. You can also manipulate the images with respect to their representation, and change contrast, brightness and edge enhancement. Measurements and annotation functions are provided.

Screen layout

The screen layout function is used to reconfigure the image area. In the default layout only one image is displayed in the image area. Other layouts can be chosen at any time using the 'Layout' buttons on the X-Ray Viewing panel.

1x1 and 3x3 layouts

To change the image area layout:



- Click on one of the layout buttons

The image area will be divided as shown.

Other layouts

To change to alternate layouts:

- Click on the 'alternative layouts' button.

The layout panel will appear.

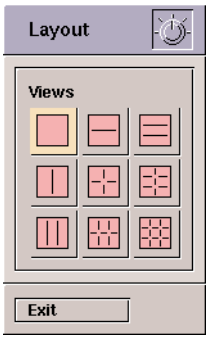


fig.3.3 Layout panel

- Click one of the screen layout options.

The image area will be divided as shown.

Changing the image order

With the image reorder function the order of the images selected for viewing can be changed.

Begin

To change the image ordering:

- Click the reorder button in the user control area.

The Reorder panel appears with the images in their original order displayed in the left image window of the reorder panel.

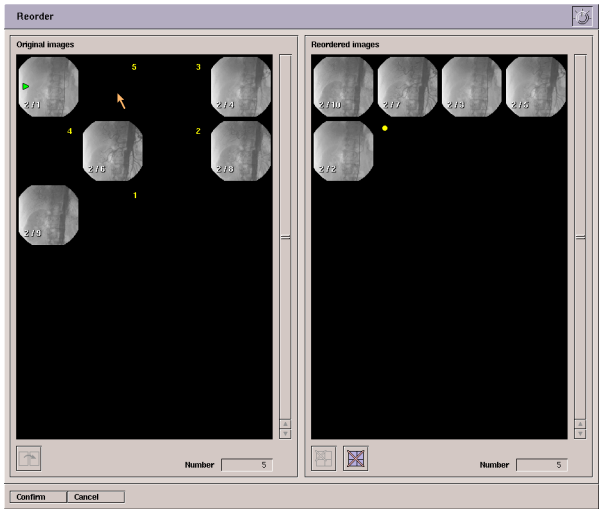


fig.3.4 The reorder panel

- Click on the image which is to be displayed as first image.

  The selected image will disappear from the original image window and appear as first image in the reordered image window. The original image is replaced by a “1” in the original image area.

- Click on another image in the original image window.

  This will be replaced by a “2” and the selected image will appear as the second image in the reordered image window.

- Repeat this process until there are no more images in the original image window.

End

- Click the »Proceed« button at the bottom of the reorder panel.

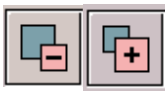
Reorder also offers the following functions:

– Select all images on the left half of the image field. All images will be displayed on the right half of the image field.

– Cancel the selection of an image. The image selected in the Reordered image window (marked with a yellow in the top left corner) will be moved back to the Original images window of the reorder panel.

– Return to the original situation, i.e. all images displayed in the Original images window of the reorder panel.

Zoom



The 'zoom out' and 'zoom in' buttons are used to reduce / magnify the images in the image area. Each time one of these buttons is activated the image(s) will be zoomed out or in by a factor of between 1.0 and 5.7.

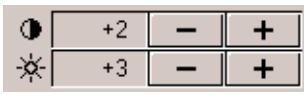
The zoom factor can be set more precisely with the zoom function.

See Chapter 5, 'Standard functions' about how to use the zoom function.

Image presentation

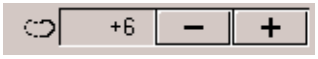
This section describes how to change the image presentation. A number of the image presentation functions (magnifying glass, shutters, image orientation, etc.) are standard EasyVision. These are available in all EasyVision application packages. For details about how to use these tools refer to Chapter 5, 'Standard functions'.

Contrast / brightness



The contrast and brightness of the selected images can be adjusted with the two + / - buttons. The numeric fields give feedback on the magnitude of contrast and brightness.

The invert button can be used to invert the image grey scale. Repeated selection of the button toggles between inverted and original grey scale settings.



The selected images can be sharpened / smoothed with the + / - buttons. The numeric fields give feedback on the magnitude of sharpening / smoothing.

Run / screen processing

Changing the contrast or brightness setting or the zoom factor will automatically affect all images in the selected run - this is known as run processing.

To restrict the changes to the images displayed in the image area select the screen processing option. The processing buttons can be activated at any time - the active function is highlighted.

Magnifying glass

Selecting this brings up a magnifying glass on the screen. By clicking the right mouse key a pop-up menu will appear with options control panel and exit. The magnifying glass control panel contains sliders for setting the magnification and the size of the area magnified.Moving the magnifying glass
The magnifying glass can be repositioned within the image area by dragging it with the mouse (left button).

To avoid unexpected results, do not place the magnifying glass over an area where measurements are to be made.

Shutters

The shutter tool allows parts of the image(s) to be masked. When selected, a control panel appears giving a choice of three shutters: horizontal, vertical, or circular.

Shutters will mask images and any text or graphic annotations on them. When the shutters are removed this hidden information will reappear.

Image orientation

The Rotate / Mirror tool allows all displayed images to be rotated / mirrored. To display the control panel, click on the 'rotate / mirror' button in the user control area. For image rotation / mirroring, click on the appropriate button on the orientation panel, or click on one of the images in the rotate / mirror panel.

The original settings can be restored with the reset view button at the bottom right of the orientation panel.

If X-Ray images are rotated / mirrored, a rotation / mirror pictogram appears on screen and film.

Measurement

The measurement function offers a range of graphic objects that can be displayed in the image area

Text annotation

The annotate function, text lines, arrows and arrows with text lines can be positioned anywhere in the image area.
Click the text 'annotation' button in the user control area to bring up the control panel.

All annotations will be rescaled when images are zoomed.

Calibration

A reference object of known size in the image can be used for calibration purposes.

To calibrate an image:

- Click the 'calibration' button in the user control area.

  A control panel appears displaying a text box and a list of French size values.

The calibration holds for the selected image and all other images belonging to the same run.

Reset functions

Clicking on 'reset view' button, resets all viewing parameters such as zoom and contrast / brightness.

Clicking on 'reset' view button, resets all display parameters such as zoom and contrast / brightness, and also resets the screen layout and removes all other function control panels from the screen.

Using the reset functions will not remove mesurement from the images.

Chapter 4
Vascular image processing

Introduction

The vascular image processing package is dedicated to view, process and analyse vascular images. The images can be obtained from neuro-vascular and general vascular acquisition systems.
Images from DSI systems are also accepted, provided DSI raw data images are used. Not all functions can sensibly used, in cases of images not suitable for processing those functions are disabled.

Main functions

The main function of the vascular image processing is to produce subtraction images from vascular contrast studies. To support optimal image subtraction, a pixel shift function is provided. With pixel shift, the mask image can be translated in sub-pixel distances to match the mask image to the contrast image when patient movement caused a mismatch between the mask and the contrast image.

In case a simple translation of the mask image is not sufficient to produce an optimal subtraction image, an automatic warp function is provided: This function will process the mask image not only by shifting the whole image, but adjusts parts of the mask locally to reach an optimal match between the mask and the contrast image

Additional functions

Two additional functions are provided in the EasyVision vascular image processing package:

– Geometrical distortion correction.

  This function eliminates the geometrical distortions of images acquired from image intensifiers. A phantom delivered with the system for the acquisition of an image that is required to apply geometrical distortion correction.
  This function is referred to as 'EasyCorrect'

  EasyCorrect can not be used for DSI images.

– Viewtrace

  The viewtrace function creates a single image from a run by accumulating the contrast density of the contrast material passing through the vascular structures.

Vascular image processing

To assess vascular stenosis a vessel analysis function is provided. The vessel analysis function is based on an automatic contour detection technique and aims at an objective stenosis evaluation.

For optimal image presentation, functions to adjust contrast, brightness and edge enhancement are provided.

Processed images as well as the original images can be printed in a manually composed film format.

A short-cut is provided to switch directly from the vascular image processing package to the Bolus Chase reconstruction package. The Bolus Chase reconstruction package can be used to navigate through a run; the current image selected in the BCR package will be shown in the vascular package on return from the BCR package.

remarks on image sources
Images from DSI systems are also accepted, provided DSI raw data images are used. Not all functions can sensibly used, in cases of images not suitable for processing those functions are disabled.

Vascular image processing

To select the vascular image processing package:

- Click the vascular button on the package switch panel.

The workstation screen shows the layout for the vascular package:

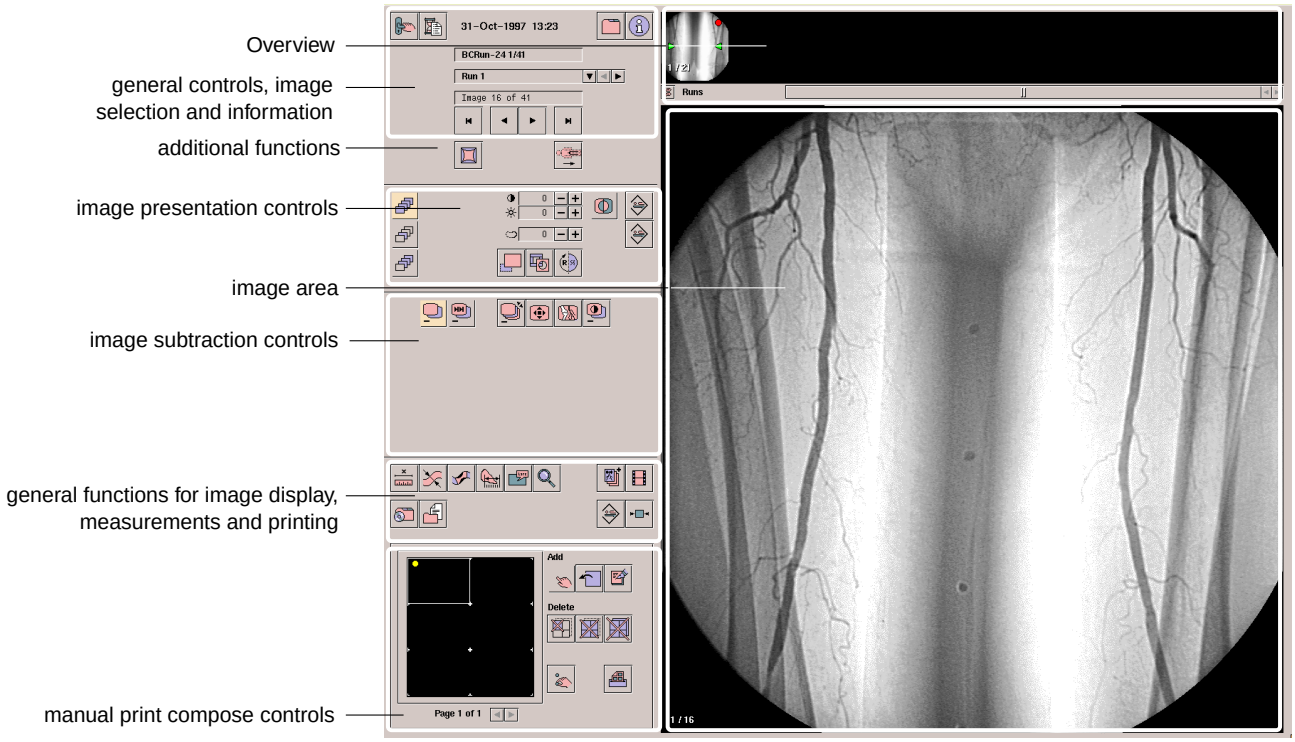


fig.4.1 vascular image processing screen

The large square area of the screen is used for image display. The upper part if the screen above the image display area is used for the overview display, here you can get an overview of the selected runs or images, and also select a run or image for viewing and analysis.

The left part of the screen shows the controls for data selection, image manipulation, and the controls for analysis and printing.

Workstation controls

The upper left hand part of the main screen shows the general workstation controls and the image selection controls as follows:

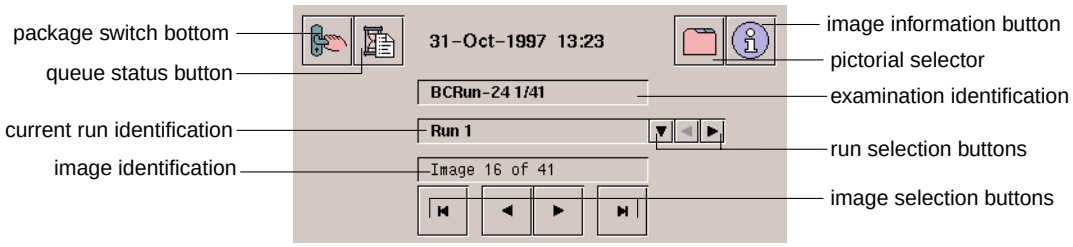


fig.4.2 Image selection

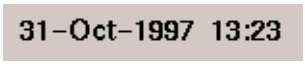
The top row shows the following controls, from left to right:

– Switch to another package.

To switch from one application package to another and to exit from the EasyVision system.

– Show queue status.

To display status information about the background process queues.



– Current date and time

– Retrieve from database

To select images and runs from the database with the pictorial selection tool.

– Image information

To show detailed information about the currently selected image.

Image selection

The selection of images to be viewed and processed in the vascular image processing package is a three level process.

1. The runs eligible for viewing and analysis are retrieved from the database.
2. The run for actual viewing and processing is selected from the images retrieved from the database.
3. The image to be viewed from the selected run is determined.

Retrieve runs from the database

Before starting actual vascular image processing, the images to be processed must be retrieved from the database. Image processing in the vascular package is run-directed. Images retrieved from the database will be accessible primarily as runs.

Begin

To select the data you want to analyse:

- Click the pictorial select button.

The pictorial select panel appears.

- Select complete examinations, selected runs or images with the pictorial select tool.

  The images you have selected are grouped run-wise, they are accessible with the run selector.

End

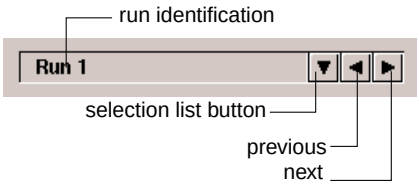
See Chapter 5, ‘Standard functions’ for details about how to use the pictorial select tool.

Run selection

After having selected the runs that you want to be available for viewing, you can select a particular run for viewing and processing. To select a run you can use the next / previous run buttons, the run selection list and the overview display.

Begin

To select a run from the runs currently retrieved from the database:



To select the next or previous run:

- Click the next or previous button respectively.

Stepping through the runs may be inconvenient when you have selected a number of runs and you want to jump to a particular run.

You can use the overview display to select another run.

- Set the overview display to »Runs«
- Click the image representing a run.

You can also select a particular run from the run selection list:

- Click the selection list button.

The following panel appears:

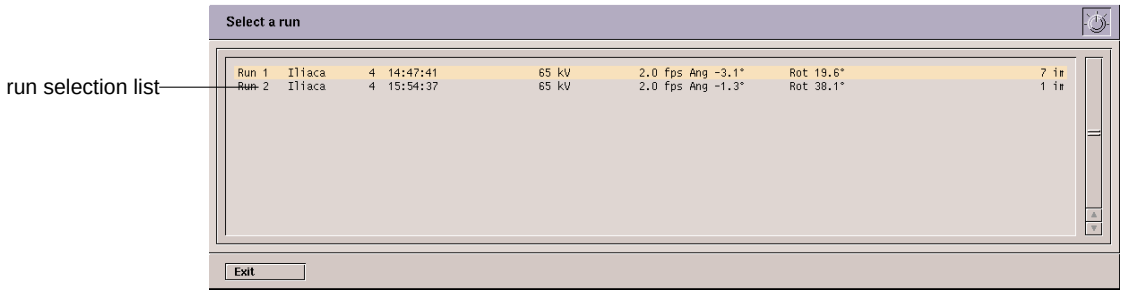

run selection list
Select a run
Run 1 Iliaca 4 14:47:41 65 kV 2.0 fps Ang -3.1° Rot 19.6° 7 im
Run 2 Iliaca 4 15:54:37 65 kV 2.0 fps Ang -1.3° Rot 38.1° 1 im
Exit

fig.4.3 Run selection list.

- Select the run that you want to analyse.

To remove the run selection list from the screen:

- Click the »Exit« button.

  - or -

- Double click the run that you want to analyse.

The run is selected and the selection list panel disappears.

Approximately the middle image of the selected run is displayed in the image display area.

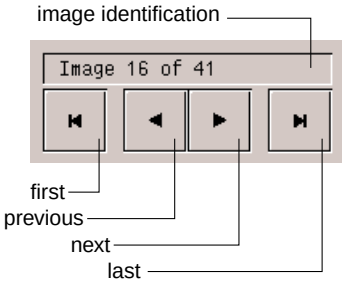
End

Image selection

Once a run is selected for viewing and processing, one of its images is shown in the image display area. With the image selection button you can select a particular image from the current run. You can display the next or previous image, or jump to the first or last image in the run. The buttons for navigating through the current run are located below the run selector on the main screen.

Begin

To select an image as the current image:



- Click the appropriate image selection buttons to navigate through the currently selected run.

The selected image is displayed, the image identification field shows the sequence number of the selected image and the total number of images in the run.

You can also use the overview display to select an image:

- Set the overview display to »Images«
- Click the image that you want to display.

The selected image is displayed.

In both cases the selected image is marked in the overview display with a red. dot.

End

Image information

The image information function provides you with detailed information about the selected run.

To show image information:

- Click the image information button.

The image information panel appears:

fig.4.4 Image information

The information contained in this panel can be printed on film with the print compose controls at the bottom left hand corner on the screen.

Overview display

At the top of the screen, above the image display area, you will find the overview display. In this area a pictorial overview is shown of the runs or images in the currently selected run. The display can show an overview of the currently selected runs, or the images in the current run. If not all images fit in the overview display, the scrollbar and step buttons can used to navigate through the images or runs. The overview display can also be used to select a run as the current run or to select an image for display in the image area.

fig.4.5 Overview display

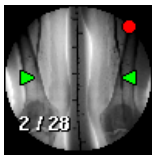
The overview display can be set in one of two modes:

– Runs

  For each run retrieved from the database, a single reference image is shown in the overview display. All original runs and those derived from the original runs (such as a viewtrace) are shown.

– Images.

  The images in the current run are shown in the overview display.



When set to show images, the first image of a run is marked with a green triangle at the left hand edge of the image and the last image of a run is marked with a green triangle at the right hand edge of the image.
The image that is shown in the image area is marked with a red dot in the upper right hand corner.

When set to show runs, the reference image shows both green triangles.
The reference image of the currently selected run is marked with a red dot in the upper right hand corner.

Image and run selection

Begin

To use the overview display for image selection:

Runs

- Select the required display mode from the menu.

If the overview display is set to show »Runs«, you can selected another run:

- Click the image which represents the run which you want to select

  The middle image of the selected run is shown in the image area.

If the overview display is set to show »Images«:

- Click the image that you want to display.

End

The selected image is shown in the image area.

Additional functions

The vascular image processing package provides you with the following auxiliary functions.

– EasyCorrect (Geometrical distortion correction).

  EasyCorrect removes to a large extent the image distortion introduced by the image intensifier.

– Viewtrace.

  The viewtrace function creates a single image, showing the contrast from selected images in the current run. This function is especially useful when the opacification of the vessels is not complete in a single image of the run but in a number of consecutive images, due to the fast passage of the contrast agent. Successive selection of images for the viewtrace image is sometimes referred to as “adding images” or “stacking images”

– Switch to bolus chase reconstruction package.

  This is a convenient short-cut to switch to the bolus chase reconstruction package. With the BCR package you can easily select a particular image from a bolus chase run or process a bolus chase run that you have already selected in the vascular package.

Image presentation controls

In the left part of the screen a particular area is dedicated to the image presentation controls as depicted below:

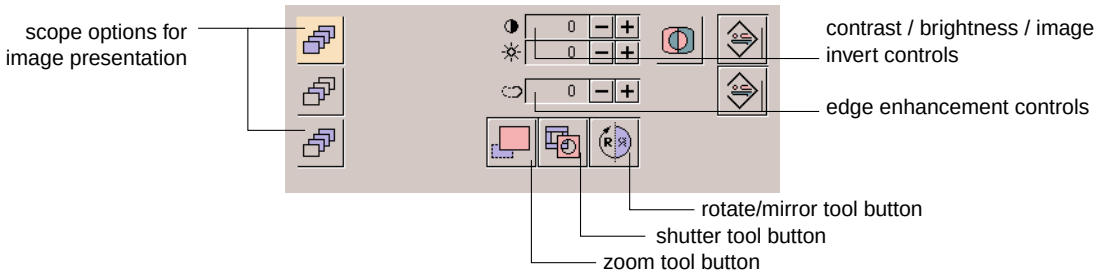

scope options for image presentation
contrast / brightness / image invert controls
edge enhancement controls
rotate/mirror tool button
shutter tool button
zoom tool button

fig.4.6 Image presentation controls

The most important image presentation settings can be controlled directly from the main screen, some additional functions can be used via their own control panels. Image presentation settings can be applied to all images or to selected images.

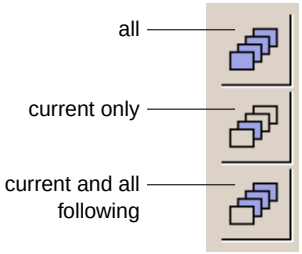
Scope of image settings

The scope of the image presentation controls can be changed. There are three options to apply the image presentation settings in the currently selected run.

– Apply to all images in the current run.
– Apply to the current image only.
– Apply to current image and all images in the current run following the current image.

The current image is the one displayed in the image area, the current run is the run to which this image belongs.

Note that selecting one of these options itself does not change the image presentation; this option only determines how the image settings will be applied after you have changed the image presentation scope option.

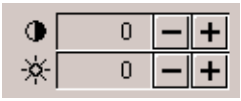


To set the scope of the image presentation controls:

• Click the appropriate option.

Contrast, brightness and invert settings

Begin To change the contrast or brightness of the images:



- Click the contrast or brightness increment or decrement button.

The relative contrast or brightness step is shown and the images are updated accordingly, taking into account the image presentation scope option.

To invert the image polarity:

- Click the image polarity option.

The grey scale display of the images is inverted.

To reset the contrast, brightness and image polarity to their original settings:

- Click the reset button to the right of the image polarity option.

End The contrast, brightness and image polarity settings are reset simultaneously.

Edge enhancement

To change the sharpness of the images:

- Click the edge enhancement increment or decrement button.

The relative enhancement step is shown and the images are updated accordingly, taking into account the image presentation scope option.

To reset the edge enhancement to its original setting:

- Click the reset button to the right of edge enhancement controls.

Image presentation tools.

In addition to the image presentation controls on the main screen, you can also use the zoom, shutter and rotate/mirror tools.

Begin

To activate one of these tools, click the appropriate button.

To zoom the images:

- Click the zoom tool button.

To control the shutter settings:

- Activate the shutter tool.

To control the rotate/mirror settings:

- Activate the rotate/mirror tool.

After clicking on of these buttons, the corresponding tool panel appears on the screen.

End

These functions are standard EasyVision functions. See Chapter 5, 'Standard functions' for details about how to use the zoom, shutter and rotate/mirror tool.

Image subtraction

Image subtraction is the main function of the image processing package. There are two types of subtraction: image subtraction and run subtraction. Normal image subtraction uses a single image from a run as the subtraction mask for all other images in the same run. For a run subtraction two corresponding runs must be available, one without and one with contrast agent injected.
To support the image subtractions, a manual pixel shift, an automatic pixel shift, a landmarking function and a subtraction contrast function is provided.

Initially the subtraction controls on the main screen are shown as follows:

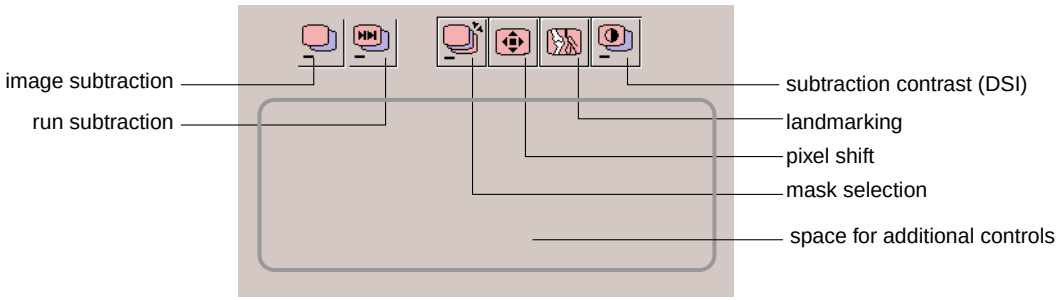


fig.4.7 Image subtraction controls

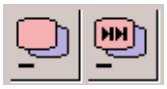
The top row shows the main controls for image subtraction and related functions. The empty space below these switches and buttons will show the additional controls for the activated processing functions.

Two options for image subtraction are provided:

– Image subtraction
– Run subtraction

Begin

To show subtracted images:



- Click the desired subtraction option.
  In case you select run subtraction, you are requested to select a mask run.

You can now apply mask selection, pixel shift or landmarking.

To show non-subtracted images:

- Click the option that you turned on.

Depending on the option selected, the other controls are enabled or disabled and the appropriate controls are shown when one of the three functions is activated.

End

Scope of image processing

The scope of vascular image processing can be changed. The setting of the scope options applies only to:

– Mask selection
– Pixel shift
– Landmarking

There are four options for the scope of image processing in the currently selected run.

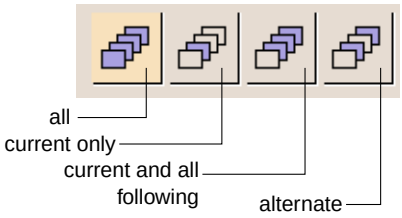
– Apply to all images in the current run.
– Apply to the current image only.
– Apply to current image and all images in the current run following the current image.
– Apply to alternate images.

The current image is the one displayed in the image area, the current run is the run to which this image belongs.

Note that selecting one of these options itself does not change the processing on the current run; this option only determines how the image processing will be applied after you have changed the processing scope option.

To set the scope for the image processing:

- Click the appropriate option



These option switches are displayed together with the specific controls of the mask selection, pixel shift and landmarking functions.

Normal image subtraction

If the default mask image is not the optimal image to be used as a mask for subtraction, you can select another image as the subtraction mask. You can set the current image as the mask image, the last image in the run, or the next or previous image (relative to the mask of the current image) as the subtraction mask.

– Selecting a mask image within a run applies only when you have selected image subtraction.

Selecting a new mask is also called 'Remasking'.

Begin

To change the mask image:

- Select the image that you want to use as the mask image.

This can be done either via the overview display or with the image selection buttons.

- Click the mask selection button.

In case you have selected image subtraction, the mask selection controls are shown as follows:

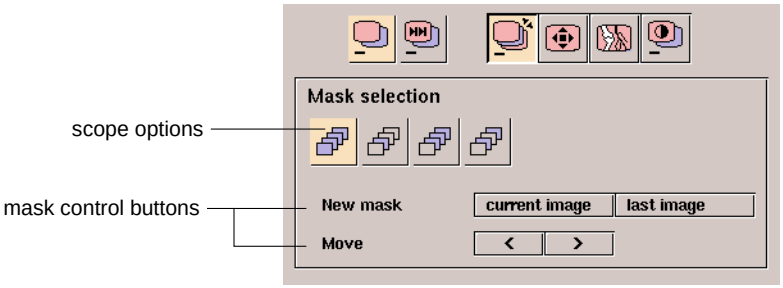


fig.4.8 Mask selection controls

- Click the »current image« button.

The current image is now used as the subtraction mask.

To use the last image of the run as the subtraction mask:

- Click the »last image « button.

To use the previous or next image as the subtraction mask:

- Click the »**<**« or »**>**« button respectively.

Note that previous or next refers to the image that is used as the mask image, not to the current image.

End

Run subtraction

This function generates subtracted images from two different runs. The system displays a subtracted image using the first image of the current run as the contrast image and the first image of the next run as the mask image.

To work with run subtraction it is assumed that you chose two runs from the database: firstly a run with the contrast images and secondly the corresponding run with the mask images.

Begin

To perform a run subtraction:

- Select the run with the contrast images.

- Click the run subtraction option switch.

The panel to select the mask run appears:

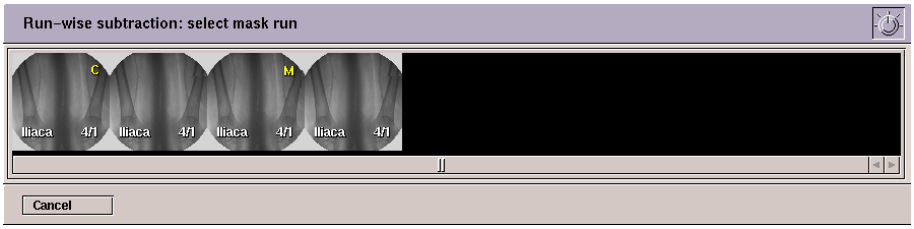


fig.4.9 Mask run selection panel

This panel shows an overview of all runs currently available as mask run. Each run is represented by a single image. The current run is marked with a "**C**" in the upper right hand corner, the mask run (if already selected) is marked with an "**M**"

- Select the run that will be used as the mask run.

- Click the mask selection button.

The additional controls now show as follows:

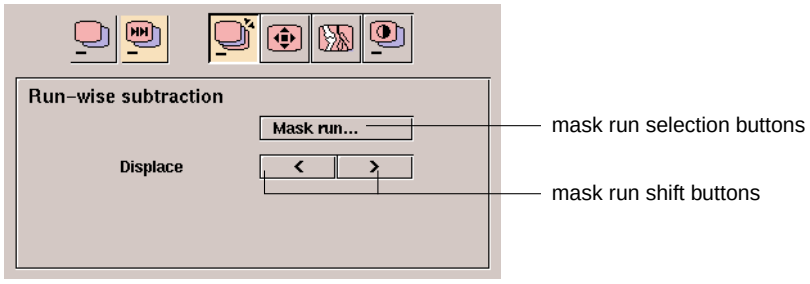


fig.4.10 Mask run controls

The mask run may be not perfectly aligned to the contrast run, the mask run can be shifted forward or backward relative to the contrast run.

- Click the »**<**« or »**>**« button to shift the mask run one image forward or backward respectively.

To select another run as the mask run:

- Click the »Mask run...« button.

The mask run selection panel will appear again.

End

- Select another run for subtraction.

Pixel Shift

To allow corrections for patient movements during contrast injection, the pixel shift function is provided. Pixel shift can be performed manually or with the auto-warp function. You can apply pixel shift to the whole image or independently to both parts of a split image.
Manual pixel shift is adjusted initially in a pixel shift ROI, after completion the whole image is updated with the same pixel shift.

The pixel shift function can not be used on images which have been processed with the EasyCorrect function.

– Pixel shift applies both to image subtraction and run subtraction.

To apply pixel shift:

- Click the pixel shift button.

The pixel shift controls are shown as follows:

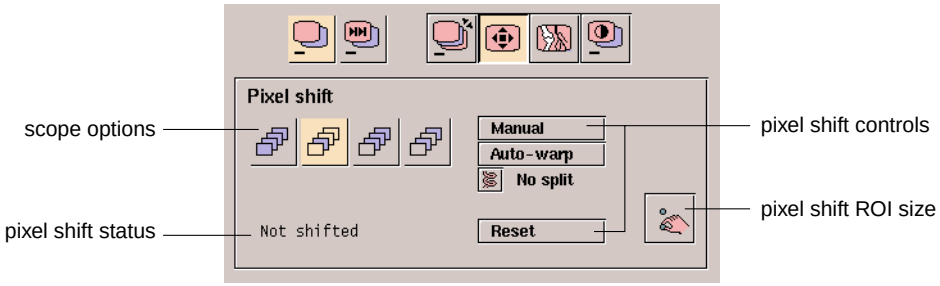


fig.4.11 Pixel shift controls

The pixel shift status shows whether pixel shift is applied or not; in case of manual shift the pixel shift offset is shown.

Manual pixel shift

Begin To apply manual pixel shift:

- Click the »Manual« button
- Move the cursor into the image at the location where you observe the mismatch most noticeable.
- Press and hold down the left mouse button.

  A magnifying rectangle appears in the image at the location where you clicked. This is the ROI where you adjust the pixel shift initially.

fig.4.12 Manual pixel shift

- Drag with the mouse to adjust the mask image to the contrast image.

  While you drag, the image is updated in the magnifying rectangle only. The cursor disappears during dragging so as not to hide any image detail.
- Release the left mouse button.

End The whole image is now updated according to the pixel shift applied in the magnifying rectangle.

An alternative is provided as follows:

Begin You can also:

- Move the cursor to the location in the image where you observe the mismatch most noticeable.
- Press and hold down the »Control« key on the keyboard.
- Press and hold down the left mouse button.

The magnifying rectangle appears in the image.

- Drag the cursor to adjust the mask image to the contrast image.

  While you drag, the image is updated in the magnifying rectangle only.
- Release the left mouse button.

  The whole image is now updated according to the pixel shift applied in the magnifying rectangle.

End
- Release the »Control« key on the keyboard.

Pixel shift ROI size

The size of the pixel shift ROI can be changed. The size of the pixel shift ROI is a trade-off between area that you need to adjust the pixel shift and performance of pixel shift update in the ROI.

Begin To change the size of the pixel shift ROI:

- Click the pixel shift ROI size button

The following panel appears:

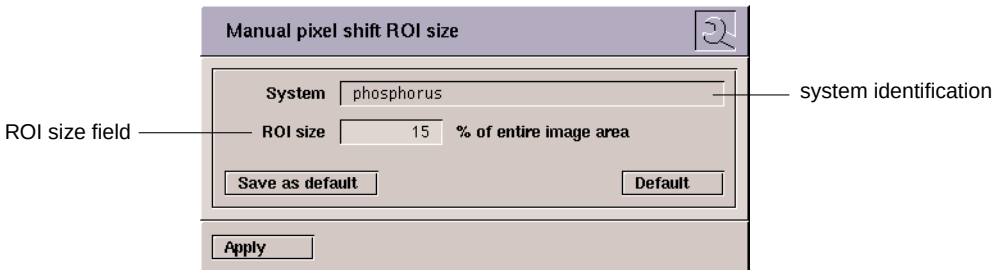


fig.4.13 Pixel shift ROI size panel

- Enter the relative ROI size.

  The ROI size is defined as a percentage of the size of the whole image. Values between 15% and 100% are allowed.

  - or -

- Click the »Default« button.

  The default size is retrieved and shown in the ROI size field.

After changing the size, you can save this value as the new default value for your system:

- Click the »Save as default« button.

To set the size of the ROI:

- Click the »Apply« button.

Subsequent manual pixel shifts will use the new pixel shift ROI size. The ROI size panel disappears.

End

Pixel warp

Manual pixel shift uses only a simple x/y translation of the whole mask image. Sometimes this only results in a good image subtraction in a part of the image, but not satisfactory in other parts of the image. In these cases the use of pixel warp may be advantageous. The warp function does not use a single translation, but will attempt to shift the mask image differently in various parts of the image.

To activate the warp function:

- Click the »Auto-warp« button.

The warp function can not be used on images which have been processed with the EasyCorrect function.

Cancel pixel shift:

To cancel pixel shift:

- Click the »Reset« button.

Split screen

Pixel shift can be performed separately in two parts of the image. You can split the image in two parts with the split screen function.

Begin To split the image

- Select from the split screen menu:
  - No split
  - Horizontal
  - Vertical

The image is split according to your selection, a blue line is displayed through the centre of the image.

If a symmetric division is not desired:

End

- Drag the blue line in the image to the desired position.

Landmarking

A perfect adjusted subtraction image will show only the contrast material delineating the vascular structures that you want to see. However, when you want to relate the vascular anatomy to the surrounding anatomy, a complete cancellation of everything except the vascular details may not be desirable. Landmarking allows you to set a partial subtraction factor. A partial subtracted image shows to a certain degree the complete image, with the contrast enhanced depending on the subtraction factor.

– Landmarking applies both to image subtraction and run subtraction.

Begin

To apply landmarking:

- Click the landmark button:

The landmarking controls are shown as follows:

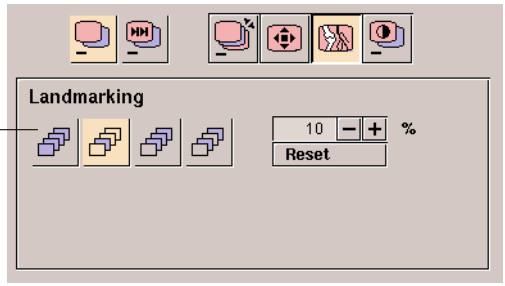


fig.4.14 Landmarking controls

To set the subtraction factor:

- Click the '**+**' or '**-**' button.

  The subtraction factor is increased or decreased with 10%.

  - or -

- Enter the subtraction factor in the subtraction factor field.

  Via the subtraction factor field you can enter any value between 0 and 100%

To cancel landmarking:

End

- Click the »Reset« button.

Subtraction contrast

To improve the contrast in subtracted images from DSI systems the Subtraction contrast function is provided.
This function is enabled only for DSI raw data images.

Begin

To change subtraction contrast:

- Click the subtraction contrast button:

The subtraction gain controls are shown as follows:

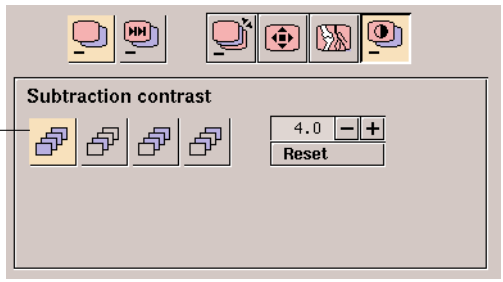


fig.4.15 Subtraction contrast controls

To set the subtraction gain:

- Click the '**+**' or '**-**' button.
  The subtraction factor is increased or decreased with a step of 0.5.

  - or -

- Enter the subtraction gain in the subtraction gain field.
  Via the subtraction factor field you can enter any value between 1.0 and 16.0

To cancel subtraction gain:

End

- Click the »Reset« button.

The alternate images scope option does not make sense for DSI images

Viewtrace

The Viewtrace function creates a new image in which vessels have their maximum opacification obtained during the contrast injection. The function takes the maximum value of each pixel from the images selected for the viewtrace image.

In case of arterial injections, where the proximal part of the vessel tree might be opacified in one image and the distal part in another, due to the speed of the contrast bolus passage, this function is especially helpful. It can also be useful when there is a difference in the arrival time of the contrast medium in symmetrical vessels (e.g. in the legs).

The viewtrace function supports both positive and negative contrast, i.e iodine and CO_2 can both be used as contrast agent. For CO_2 the use of the viewtrace function is advised, due to the flow characteristics of CO_2 as contrast agent.

The viewtrace function shows its resulting image in the main image display area, the images used for the viewtrace image must be selected from the overview display. The viewtrace function allows only for one trace image composed from a run.

The Viewtrace function accepts images from Integris and DSI systems.

Set up viewtrace

Begin

To create a viewtrace image:

- Click the viewtrace button.

The following panel appears:

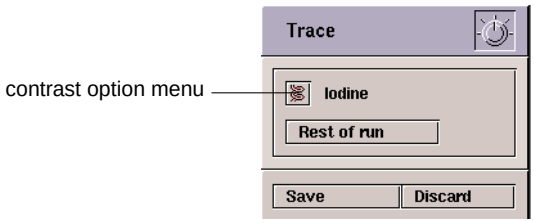


fig.4.16 Viewtrace panel

The current image is now taken as the trace image. If a trace image existed already, you are asked to confirm the deletion of the old trace image.

The overview display must be used for image selection; if it was not set to show images, it will automatically set to show the images of the current run.

To function properly:

End

- Select the correct contrast option.

Selecting images for viewtrace

Begin Now the images can be selected for the viewtrace image:

- Click the images in the overview display that you want to use for the viewtrace image.

A red dot appears in the upper right hand corner of the selected images in the overview display.

To exclude a selected image from the viewtrace image:

- Click in the overview display on a selected image.

To select a number of subsequent images:

- Drag in the overview display, starting at the first image and ending at the last image to be included in the trace image.

To select all images from and including last of already selected image to the end of the run:

- Click the »Rest of run« button.

After each change of the selection, the viewtrace image will be built again.
End This may take some time.

Finishing viewtrace

Begin To store the viewtrace image in the database:

- Click the »Save« button.

The viewtrace image is stored as a single image run in the database in the same examination as the run from which it was composed.

To exit the viewtrace function without saving the trace image:

- Click the »Discard« button.

The viewtrace image is discarded and not stored in the database.

End The Trace panel disappears.

General viewing and measurement functions

Below the area dedicated to the image presentation controls, you will find a number of buttons to activate general viewing functions, measurement and auxiliary functions.

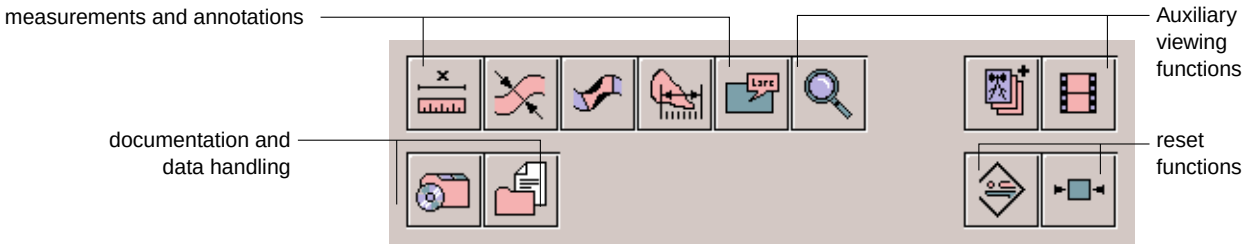


fig.4.17 General viewing and measurement functions

The functions provided in this area on the main screen are listed below

Measurements and annotations

– Calibration
To calibrate images for measurements using an object of known size in the image.

– Vessel diameter
To measure two diameters in a vessel manually and calculate the difference. Useful for computation of percentage stenosis.

– Automated vessel analysis
Allows objective and reproductive assessment of vessel obstruction.

– Measurements
To perform various types of measurements such as area, distance, angle.

– Image annotations
To put annotations on images.

Except for the automated vessel analysis function, the above mentioned functions are standard EasyVision functions. See Chapter 5, ‘Standard functions’ for details about how to use them.

The automated vessel analysis function is described in detail in section ‘Automated vessel analysis’ on page 4-89.

Auxiliary viewing functions

– Magnifying glass
To enlarge part of an image.

– Viewtrace
To compose a single image from a run showing all contrast material passing trough the image

– Movie tool
To view images as a movie with variable speed and direction.

The magnifying glass and the Movie tool are standard EasyVision functions. See Chapter 5, 'Standard functions' for details about how to use them.

The Viewtrace function is a special function for the vascular package. See section 'Viewtrace' on page 4-85 about how to use this function.

Documentation and data handling

– Data handling short-cuts
Frequently used data handling functions without having to switch to the data handling package. Includes copy to optical disk, copy to other database and remove from database.

– Compose review folder
To compose manually a collection of images and comments for later review.

The documentation and data handling functions are standard EasyVision functions. See Chapter 5, 'Standard functions' for details about how to use them.

Reset functions

– Reset image presentation
To reset all image presentation settings such as zoom and contrast/ brightness to their initial settings.

– Reset all
To reset all image presentation settings such as zoom and contrast/ brightness to their initial settings and to reset all display settings such as selective image presentation. Also removes any tool panel present on the screen.

Automated vessel analysis

The Automated vessel analysis function is allowed on images acquired with Integris, DCI and DSI systems. The function can be applied to normal images as well as to Viewtrace images. DSI images must be unprocessed images. The Automated vessel analysis function is not clinically validated for DSI images. A warning panel is displayed when using DSI images.

Automated vessel analysis allows objective and reproducible evaluation of the severity of vessel narrowing.

Begin To perform an automated vessel analysis:

- Click the automated vessel analysis button.

The following panel appears:

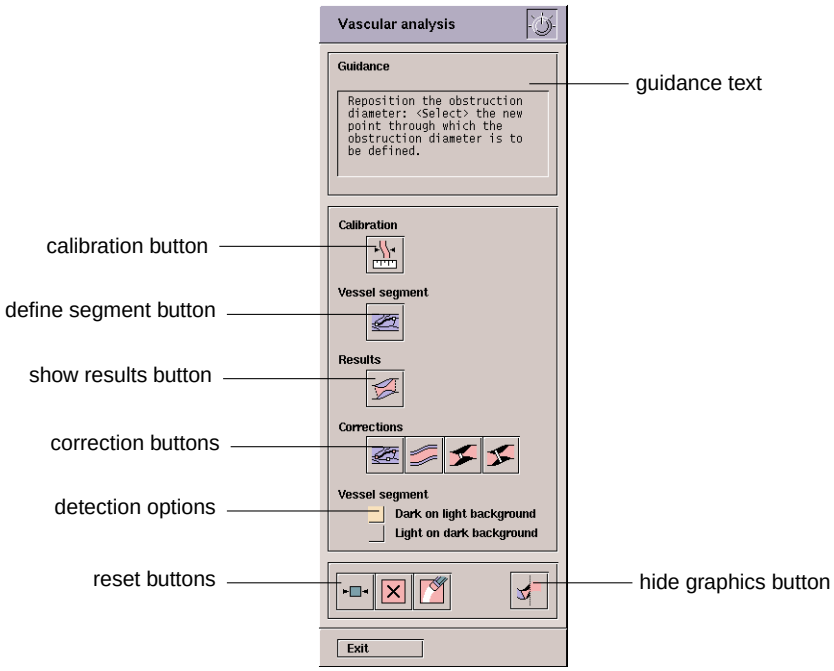
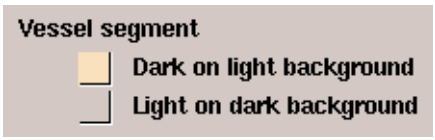


fig.4.18 Automated vessel analysis panel

The top part of the panel shows the text to guide you through the steps to perform an automated vessel obstruction analysis.
The middle part shows the buttons to activate the actual analysis and make corrections if necessary.
The lower part shows the buttons to reset and to remove the graphics produced by the automated vessel analysis.

Set detection mode

Before automatic contour detection can be performed you must set the detection mode. Depending on whether iodine containing contrast fluid or a CO_2 contrast injection is used; or the image display is inverted, the vessels may show up light on a dark background or dark on a light background. To avoid confusion about how to define the detection mode in any of the possible combinations, you just select how the image is presented.



To set the detection mode:

- Click required detection option.

Calibration

To obtain absolute figures about the diameter on the vessel at the site of the stenosis, the image or run which you use for analysis has to be calibrated. With the calibration function for the automated vessel analysis tool you can use the catheter that was used for contrast injection as the calibration object. After you have indicated the segment of the catheter to be used for calibration, the contours of the catheter are automatically detected. The average diameter is determined and the calibration factor is computed using the actual diameter of the catheter that you must provide.

The accuracy of the calibration factor depends on the displayed size of the catheter. The accuracy will improve if the selected image intensifier field is smaller and/or the size of the catheter is larger.

Begin Select an image on which the catheter is clearly visible

To start the calibration:

- Click the calibration button.

The cursor changes into a cross hair.

- Click in the centre of the catheter at the begin of the segment that you want to use for calibration.
- Click in the centre of the catheter at the end of the segment that you want to use for calibration.

The image shows two white lines at the edges of the segment that you selected for calibration.

The following panel appears:

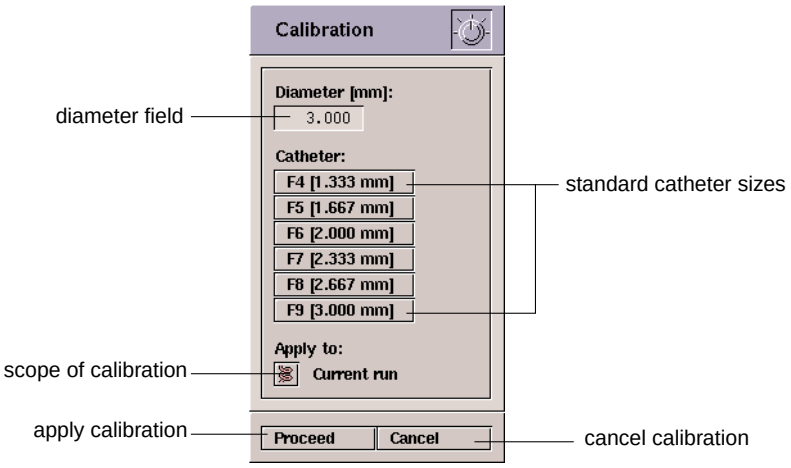


fig.4.19 Calibration panel

Verify whether the automatic detection of the catheter was correct or not.

If the contour detection was not correct:

- Click the »Cancel« button.
- Try again, using a different segment of the catheter.

If the contour detection was correct:

- Click one of the predefined catheter sizes.

  There are buttons available for the most frequently used catheter sizes (French 4 - French 9)

  - or -

- Enter the diameter in the diameter field if the diameter is other than one of the predefined values.

To determine the scope of the calibration:

- Select from the scope of the calibration menu:

– Current run or

– Current image

To finish calibration:

- Click the »Proceed« button.

The calibration factor is computed and the computed diameters are displayed in mm on the result panel.

End

Automatic contour detection

The measurement of vessel obstructions in based on automatic contour detection of the affected vessel segment. After you have indicated the begin and end point of the vessel segment the contours are detected in a two stage process. Firstly the path-line in the vessel segment from the starting point to the end point is automatically determined and secondly the edges of the segment are detected. A reference diameter is also derived from the indicated vessel segment. You have to define the vessel segment sufficiently long to include unaffected parts of the vessel proximal and distal to the obstruction. This is required to derive the reference diameter.

Begin

To perform the automatic contour detection:

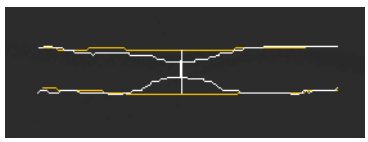
- Select an image which clearly shows the obstruction to be analysed.
- Use the zoom tool to display the obstruction at an appropriate magnification.

- Click the vessel segment button.

The cursor changes into a cross-hair. To define the vascular segment for analysis:

- Click a point in the centre of the vessel proximal to the obstruction.
- Click a point in the centre of the vessel distal to the obstruction.

The contour detection starts, after completion the detected contours are shown in the image



The detected contours are shown as white lines, the reference contours are shown as brown lines. The position and size if the obstruction and the reference diameter for the obstruction are also shown.

Begin

The vessel segment that you want to evaluate, should preferably be in the centre of the image. You cannot enter a start or and end point of a vessel segment at the edge of an image.

If the contour detection is apparently incorrect, you can try the automatic detection again using slightly different start and end points or you can make manual corrections.

Corrections

If the automatic detection of the contours or the site of the obstruction are not satisfactory, you can make manual corrections. You can make adjustments to the path-line, correct the contours and adjust the position of the obstruction and the reference diameter.

Path-line correction

The path-line is automatically determined as initial reference to detect the contours of he vessel segment an to determine the reference diameter along the vessel segment.

Begin

To correct the path-line:

- Click the path-line correction button.

Only the path-line is now displayed as a yellow line. If this line deviates considerably from the centre of the vessel:

- Click in the centre of the vessel segment, at the point where you want an adjustment.

The path-line is now automatically re-evaluated and displayed. The corrected path-line does not necessarily run through the point that you indicated.

End

Contour correction

You can change the automatically detected contour manually. You can change a contour by replacing a portion of the contour by a new piece that you draw manually, you can extend the contour at the endpoints or you can cut off a part from the ends.

To start editing a contour manually:

- Click the change contour button.

The detected contours are now displayed in yellow.
You can now start editing a contour. As long as the change contour function is active, you can perform on of the editing possibilities.
To stop editing:

- Click the change contour button again.

  - or -

- Activate one of the other buttons on the automatic vessel analysis panel

Replace contour segment

Begin To replace a portion of a contour manually:

- Move the cursor to the point where you want to start drawing a new piece of the contour.
- Left click at this position.
- Move the cursor along the edge of the vessel segment.

The new contour is drawn in the image, leaving the old contour visible. You do not need to keep the left mouse button depressed.

- Continue drawing until you join the old contour at a position that you consider correct.
- Stop drawing and click the left mouse mutton again.

End The old part of the contour is now replaced by the new part that you have drawn.

Extend contour

Begin To extend a contour at one of its ends:

- Move the cursor to the end that you want to extend. The cursor should be on the handle at the end of the contour.
- Click the left mouse button.
- Move the cursor to extend the contour.

The contour extension is drawn in the image while you move the cursor.

- Stop drawing and click the left mouse mutton again.

End The contour is now extended by the new part that you have drawn.

Shorten the contour

If you consider a contour line to be too long, you can cut of part of the contour at the ends.

Begin To cut off part of a contour at one of its ends:

- Move the cursor to the point on the contour which you want to be the new endpoint
- Click the middle mouse button.

The contour is sensitive for cut-off at approximately 20% of its length at the end points.

End The part of the contour between the old end point and the position where you clacked is now erased.

Correction of obstruction and reference position

The automatic vessel analysis function determines the site of the maximal obstruction in the indicated vessel segment. The position of the reference diameter for the computation of the obstruction values is taken at the same position. If you consider these positions not entirely correct, you can change therm.

Begin

To change the obstruction diameter position:

- Click the obstruction diameter button.
- Click in the vessel at the position where you want to measure the obstruction diameter.

The obstruction diameter is now determined at the new position. The reference diameter position is also taken at this position.

The reference diameter is derived from the computed reference contours

If you want to change the reference diameter position independently:

- Click the reference diameter button.
- Click in the vessel at the position where you want to measure the reference diameter.

The reference diameter is now measured at the new position, the obstruction diameter is not changed.

The reference diameter is measured from the actual vessel contours

End

The display of the obstruction or reference diameter is updated, and the new diameters are used for the subsequent display of results.

Contour verification

To verify the contour that you are changing:

- Press and hold down the ‘Hide graphics’ button.

The graphics are hidden as long as you hold the left mouse button down. Releasing the button shows the graphics again. Switching between hide and display gives you an impression if the contour is correctly drawn along the edges of the vessel segment.

Results

After you have performed the contour detection and calibration, the results of the automated vessel analysis can be shown. A graphical representation is superimposed on the location where the obstruction was detected, a graph showing the diameter along the path line and a table with numerical data derived from the diameter curve is displayed.

To show the results of the vessel analysis:

- Click the result button.

The image shows now the results:

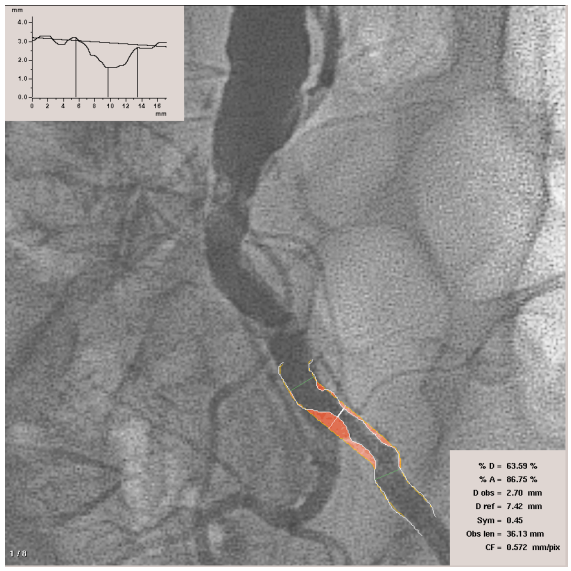
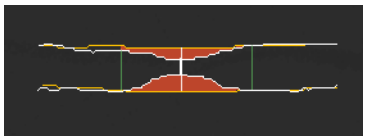


fig.4.20 Vessel analysis result display

The diameter curve is shown in the top left hand corner of the image, the numerical results are shown in the lower right hand corner.

An indication of the intravascular plaque is superimposed on in the image.



In the vessel segment, the locations of minimal obstruction diameter is indicated and the proximal and distal boundaries of the obstruction are marked by green lines perpendicular to the path line. These location markers correspond to those indicated in the diameter graph.
The areas between the constructed reference contours and the detected luminal contours within the obstructive region are shaded; this area is a measure of the area of the atherosclerotic plaque

The graphical results are shown as follows:

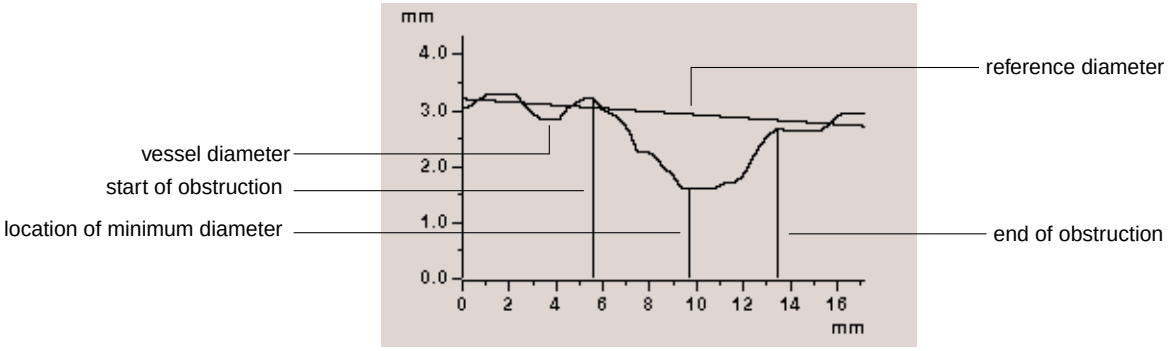


fig.4.21 Diameter graph

The diameter graph shows:

– The computed vessel diameter curve.

  This diameter is computed from the detected contours.

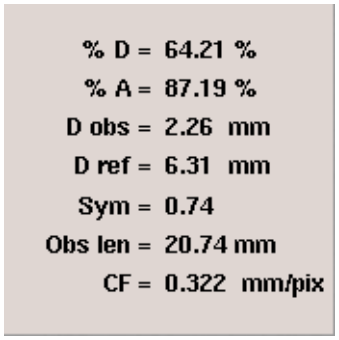
– The reference diameter curve

  The reference diameter is a linear approximation of the vessel diameter without obstruction.

– The locations of:
  – the start of the obstruction
  – the minimum diameter
  – the end of the obstruction

The reference diameter for the computation of the percentage obstruction is taken from the approximated diameter curve at the location of the obstruction.

The numerical results are shown as follows:



Item	Description	Unit
% D	Percentage Diameter stenosis	%
% A	Percentage Area stenosis	%
D obs	Obstruction diameter	mm
D ref	Reference diameter	mm
Sym	Symmetry of the obstruction	
Obs len	Obstruction length	mm
CF	Calibration Factor for image	mm/pixel

fig.4.22 Numerical results

The percentage area stenosis (A) is based on the assumption of circular cross-sections at the obstruction and reference position.

Note: The calibration factor is computed as mm/pixel in the original image matrix, contrary to the calibration factor as computed by the VISUB system. The VISUB system uses a calibration in mm/screen pixel.

Switch to Bolus Chase Reconstruction

When working with vascular images, one of the possible examination types is a bolus chase run. When you have selected a bolus chase run, you can switch immediately to the Bolus Chase reconstruction package without having to select again the same run within the bolus chase reconstruction package. This allows you to navigate easily through a bolus chase run and find quickly a particular image. The selected image is shown in the vascular package on return from the BCR package.

Begin To use the BCR package from the vascular image processing package:

- Select a bolus chase run.
- Perform vascular processing if required, possibly a run subtraction.

  The BCR package has the option to display subtracted images. (For the original images only, not for the Bolus chase reconstruction image).

Be sure that you have selected the bolus chase run **with** contrast for viewing in the vascular package before you switch to the BCR package.

To show a bolus chase run in the BCR package:

- Click the BCR button.

  The EasyVision software switches now immediately to the BCR package. The bolus chase run that you selected in the vascular package is now available in the BCR package.
  The BCR package shows the image that was selected in the vascular package.
- Navigate to the image that you want to show.
- Proceed with any processing you want to perform in the BCR package.

- Click the package switch button on the BCR screen.

  The EasyVision software switches now back to the vascular package without showing the package switch panel.

The bolus chase run is still selected for viewing and analysis in the vascular package and the image selected in the BCR package is now shown in the vascular package.

End

EasyCorrect

X-Ray images obtained with an image intensifier exhibit certain distortions, one of which is the geometrical distortion. Geometrical distortion is caused by the curved input screen of the image intensifier, imperfections of the electron optics of the image intensifier and environmental influences such as the earth's magnetic field.

Geometrical distortions

Images obtained with an image intensifier will show distortions, e.g pincushion distortion and S-curve distortion. Although a good image intensifier is designed to show minimal distortion, it is not possible to eliminate geometrical distortion completely. In general this distortion does not hamper routine examinations, but evaluation of straight lines may be difficult. When the exact location of anatomical structures is important (e.g. images to be used for stereotactic surgery) or when measurements are to be made from images obtained with an image intensifier, the results of these measurements suffer from inaccuracies due to geometrical distortion.

Geometrical distortion correction

The degree of geometrical distortion can be determined by imaging a special phantom. This phantom consists of a perspex slab with lead beads on a fixed grid. With the aid of the phantom a correction image can be made. From the known geometry of the phantom and the image which it produces, correction factors can be computed. With these correction factors new images can be computed from the original distorted images to obtain minimally distorted images.

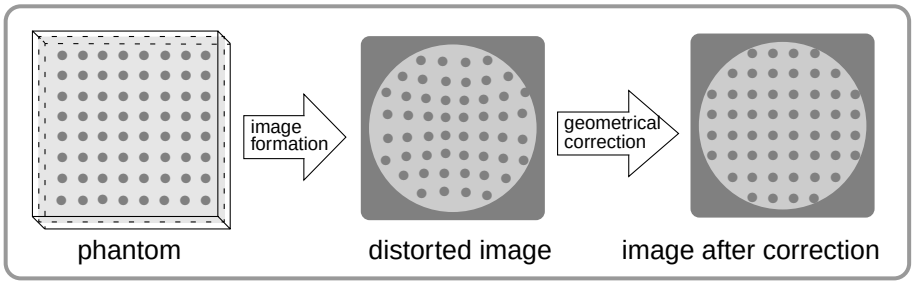


fig.4.1 Geometrical distortion correction

The images that must be corrected and the calibration image from the phantom must be made under the same conditions. The phantom will be attached to the image intensifier and the phantom image must be acquired. Afterwards the images obtained from the patient can be corrected with the correction factors derived from the phantom image.

30-5-2000

Note that the correction algorithm is based on knowledge about the phantom provided with the EasyCorrect option for the EasyVision workstation. Consequently correction will only work with calibration images obtained from this phantom.

The pixel shift function and pixel warp function can not be used on images which have been processed with the EasyCorrect function.

Requirements for EasyCorrect

The EasyCorrect function is designed to correct images acquired with Philips Integris systems. More specific, EasyCorrect may be seen as a post-processing extension to the Integris digital acquisition and viewing sub-system.
The actual need for geometrical distortion correction is for special applications only. The geometrical distortion correction is mainly intended for vascular applications, especially stereotactic radio-surgery.

Correcting biplane acquisitions

EasyCorrect is used for a particular combination of X-ray tube and Image Intensifier in a certain geometry.

When biplane acquisition must be corrected, the acquisition with the EasyCorrect phantom must be performed separately for both imaging chains.

Requirements for images

Images to which you want to apply geometrical correction must fulfil a number of requirements. Some of these requirements can be checked by the EasyVision software, so that you will be prevented to apply geometrical corrections when it is not allowed. The requirements for geometrical distortion correction are discussed below.

Acquisition requirements

The requirements for the acquisition protocol are the following:

– In addition to the diagnostic images, phantom images must be acquired.

– The phantom images must be created using the phantom delivered with the EasyVision workstation for the purpose of geometrical distortion correction.

– The phantom must be properly attached to the image intensifier.

No shutters or other objects (e.g. the table) must be present in the phantom image.

These requirements can not be checked by the EasyVision software. If substantial deviations from these requirements are made, phantom images can not be recognized as such. Smaller deviations may lead to unpredictable results.

Requirements for image type

The following requirements apply to both the images to be corrected and the phantom images.

– The images must be produced by a Integris system.
– The images must be original images, not from photo files.
– The images must have a matrix size of 480^2, 512^2, 960^2 or 1024^2.
– Other matrix sizes cannot be handled by the EasyCorrect function.

These requirements are checked by the EasyVision software. If one or more of these requirements is not met, the correction is not carried out, and the reason is displayed.

Relations between diagnostic and phantom images

The correction of a diagnostic image requires that there is a phantom image that relates to the diagnostic image in the following ways.

– The phantom image(s) must be contained in the same examination.
– The phantom image(s) must be acquired with the same image intensifier as the diagnostic images.
– The difference in angulation must be less than 2 degrees.
– The difference in rotation must be less than 2 degrees.
– The difference in source to detector distance must be less than 50 mm.
– The image matrix size must be the same.
– The projection plane must be the same (frontal or lateral).

One additional requirement can be enforced:

– The acquisition date must be the same.

  This check can be switched on or off with the options for the EasyCorrect function (see section 'EasyCorrect options', page 4-105).

These requirements are checked by the EasyVision software. If one or more of these requirements is not met, the correction is not carried out, and the reason is displayed.

.

Using EasyCorrect

The EasyCorrect function is used to correct images obtained from an image intensifier for all types of distortions caused by the image intensifier. The correction is applied to all images that you have selected. The EasyCorrect function creates a new corrected image for each original image. These images have the same characteristics as the original image. The corrected images are stored in the database in the same examination, as a new run.
Corrected images are marked to distinguish them from original images. The original images will be retained.

Before you apply geometrical distortion correction, you must select the images that you want to correct. You may select just a few images from a run, it is not necessary to select the whole run.

You do not need to select the phantom images, they are retrieved automatically by the EasyCorrect function.

Begin To initiate EasyCorrect:

- Click the EasyCorrect button.

The following panel appears:

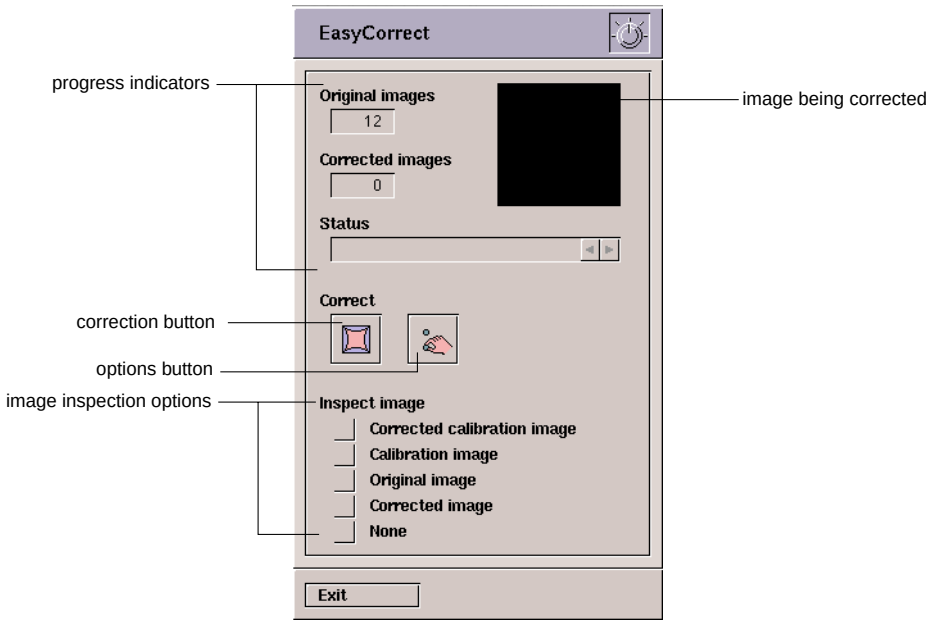


fig.4.2 Geometrical distortion correction tool

The number of images to be corrected is shown in the »Original images« field.

To start the actual geometrical distortion correction:

- Click the correction button.

If the selected run fulfils the requirements for EasyCorrect, the actual correction is started.

The correction progress indicator shows:

- the number of corrected images.
- a small copy of the image being corrected.
- a status message about the correction process.

- Click the »Exit« button.

End The corrected images are added to the selected images and shown in the image overview at the top of the screen.

EasyCorrect options

Before starting the actual geometrical distortion correction, you may set a number of options to be used during correction.

Begin To set the EasyCorrect options:

- Click the properties button on the EasyCorrect panel.

The following panel appears:

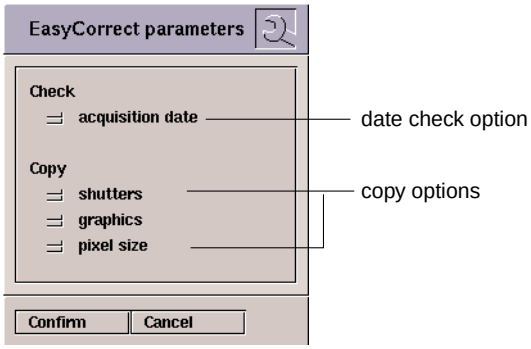


fig.4.3 Geometrical distortion correction options

To verify whether the date of acquisition of the phantom image(s) and the examination are the same:

- Click the »Acquisition date« option.

  When the date check option is switched on, and the dates of the phantom image acquisition and the diagnostic images differ, the geometrical distortion correction will not be carried out.

While performing the actual distortion correction some of the image attributes from the original images can be copied to the newly created image series. You can select one or more from:

– shutters
– graphics
– pixel size

  For original images that have been calibrated, the pixel size is established and stored in the database. This pixel size attribute is copied to the corrected images.

• Click the desired copy option(s).
• Click the »Confirm« button

End The properties that you have selected will be applied during correction.

The coordinates of shutters and graphics are not converted by the image correction algorithm.Shutters may not cover exactly the image area on the corrected image as they did on the original. Graphics may also not be located exactly at the same location in the corrected image; especially when located off-centre.

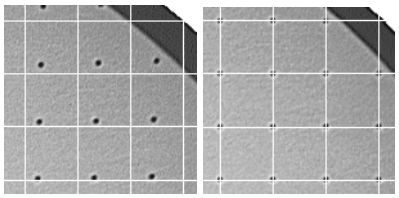
You are advised to copy only graphics concerning gross anatomy or general information (e.g Left/Right indicators). If you want to add annotations on precise image locations, use the annotation function on the corrected images.

Image inspection

If you are in doubt about the results of the correction, you can inspect the original and corrected images before you Exit the correction tool.

You can select from four options:

Calibration image comparison



detail of uncorrected image

detail of corrected image

– Corrected calibration image

  This is the corrected phantom image, which was created from the original uncorrected phantom image.

– Calibration image

  This is the phantom image that is used for the correction.

  When you select the corrected or uncorrected phantom, a grid is overlaid on the image which shows the relation between the computed positions of the lead beads in the phantom and the actual positions in the images.

  Toggling between the corrected and uncorrected calibration image may reveal problems in the phantom image.

– Original image

  The original diagnostic image selected for viewing is shown.

– Corrected image

  The corrected image corresponding to the original image is shown.

  When you select the original or the corrected image, no grid is shown. Toggling between the original and the corrected image shows the relation between the two and might reveal problem areas.

– None

  The viewing area is displayed as if EasyCorrect was deactivated, the control panel remains on the screen.

Printing on film

At the lower left hand part of the main screen you will find an area where you can compose manually print sheets for the vascular image processing package. This function is similar to the manual print compose tool available in the other packages; but this manual print function in the vascular package will create print jobs composed from this package only.

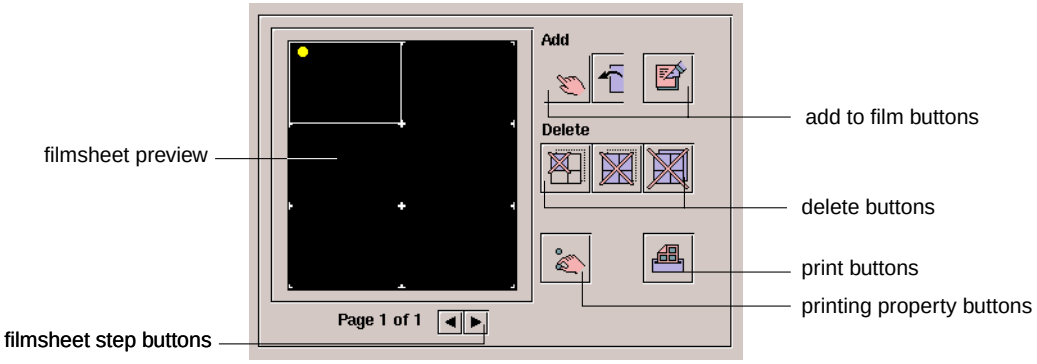


fig.4.4 Manual print controls

Printing images and information

Begin To print images from the vascular image processing package:

- If required, change the print job properties.
  You can change a.o. the printer, print priority, film layout.
- Compose the filmsheets you want to print
  Use the add, delete and step buttons to create one or more filmsheets.

- Click the print button.

End The sheets that you have composed will be sent to the printer.

To add images and information

You can add images and image information to the print sheets. On which position an image will appear depends on the automatic selection option in the print properties panel.

Begin To add the image in the main image area to the filmsheet:

- Click the add image button

To add annotations to the filmsheet:

- Click the add annotations button.

To add image information to the filmsheet:

- Click the image information button.
  The image information panel appears.

- Click the pick option switch.

The cursor changes into the pick cursor.

- Click in the image information panel.

You can also add the image in the main image area to the filmsheet with the pick option.

To switch off pick and place film composition:

End

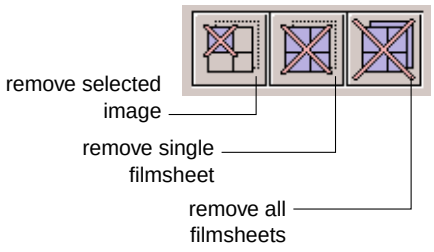
- Click the pick option switch again.

To remove images and information

You can remove selected images (or textual information), a single filmsheet or all filmsheets from the composed print job.

Begin

To remove images or annotations:



To remove an image (or text frame) from a filmsheet:

- Select the filmsheet with the image to be removed with the step buttons.
- Click the image to be removed.
- Click the remove filmsheet button.

To remove a single filmsheet:

- Select the filmsheet to be removed with the step buttons.
- Click the remove filmsheet button

To remove all filmsheets:

End

- Click the remove all filmsheets button

Chapter 5

Bolus chase reconstruction

Introduction

Bolus Chase reconstruction is a method to create an overview image of the peripheral vasculature of the legs from a series of images obtained with a single contrast injection above the bifurcation of the aorta. The reconstructed image can be printed with dedicated print formats.

The Bolus chase reconstruction package is designed for images that are acquired from Philips systems, but can also be used for images that are acquired from third party acquisition systems or third party workstations. The acquisition procedure used for images obtained with third party systems must be similar and adequate.

Important considerations

Bolus Chase Reconstruction images should never be used for diagnostic purposes. Philips Medical Systems will not accept responsibility for diagnoses based only on a bolus chase reconstruction image.

The algorithm for Bolus Chase Reconstruction is specifically designed for a series of images of the lower peripheral arteries with contrast injection. It takes specific image features of these types of images into account. Therefore it should never be used for reconstruction of series of spine or colon images. These must be reconstructed in the appropriate packages.

Philips does not guarantee the quality of the Bolus Chase reconstructed image if the original image series is acquired from other than Philips systems.

Items that support the acquisition procedure, like filter set, generator programming and ruler, are not provided by Philips in case of third party acquisition systems or workstation.

The quality and convenience of such a procedure may therefore be diminished compared to the Philips procedure and is the responsibility of the user.

Bolus Chase acquisition

Bolus Chase is a digital X-Ray acquisition technique that allows the flow of contrast medium to be tracked in one continuous movement of the table. A single contrast injection is sufficient for overview of the lower peripheral arteries. During the examination a series of images is generated, referred to as a 'run', with considerable anatomical overlap between successive images. This image overlap is used in the reconstruction of a BCR image from the images in the original run.

Requirements for bolus chase examinations

A bolus chase acquisition series has to meet a number of requirements to allow for an accurate Bolus Chase Reconstruction. These requirements can be summarized as follows

- smooth and continuous unidirectional movement combined with a sufficiently high frame rate
- correct injection of contrast medium
- 38 cm image intensifier format
- image intensifier set close to the patient
- correct positioning of peripheral filter and ruler.

The next sections will give detailed information about these acquisition requirements.

Smooth and continuous unidirectional movement

For accurate reconstruction, tracking of the contrast medium must be smooth, continuous, and unidirectional. The direction of movement must be in one direction only. Lateral movements are also not allowed.
Philips acquisition systems provide various facilities for movement control. A speed controller can be used in most systems to acquire scans, in some systems the table needs to be moved longitudinally.
Integris V3000 systems allow an automatic procedure for table movement based on an APR defined speed profile. See the user instructions supplied with the acquisition system for further information on the movement control options.

Frame rate

For a successful reconstruction of a BCR image, there must be sufficient overlap between subsequent images in the bolus chase run.

Note: displacement between subsequent images must be < 3 cm

Example:

For a total table displacement of 100 cm the number of images required is greater than 33. The displacement between images will then be smaller than 3 cm. The frame rate should be adjusted in anticipation of the flow in the vessels.

Use the appropriate bolus chase APR and kV-reduction technique.

Correct injection of contrast medium

A sufficient quantity of contrast medium must be injected to create a contrast bolus with sufficient length and concentration for tracking. The injection should always be coupled to the start of the acquisition procedure.

Rule of thumb:

- concentration: 360 mg/ml Iodine
- volume: 60 - 80 ml
- flow rate: 8 - 12 ml/s

This gives an injection time of 5-10 seconds.

More specific information is contained in the user documentation supplied with the acquisition system.

Image intensifier close to the patient

The image intensifier should be positioned close to the patient, to ensure complete coverage of the patient's anatomy. The distance to the patient should be constant during acquisition to keep the enlargement factor constant.

The 38 cm image intensifier format must be used; both legs should be visible in the bolus chase run.

Correct positioning of peripheral filter and ruler

To obtain a good image quality, direct radiation on the image intensifier must be avoided. Therefore the peripheral wedge filters must be correctly positioned: the centre filter between the patient's legs, with the wide end towards the feet, and the two side filters as close as possible to either leg. The ruler must be included with the filters to increase the accuracy of the bolus chase reconstruction.

Ensure that patient movement is prevented during acquisition in order to avoid reconstruction artefacts.

For good image quality the filters and ruler must be carefully positioned.

If necessary, use straps to prevent leg movement.

a: left filter
b: middle filter
c: right filter

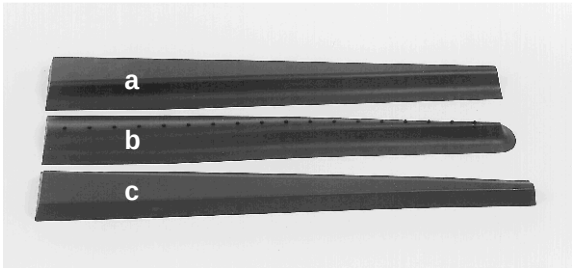
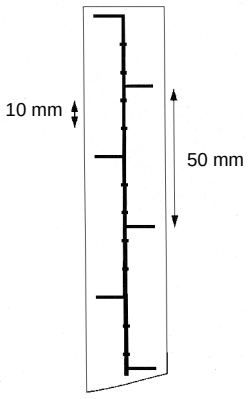


fig.5.5 Peripheral filter



BCR ruler

Automatic reconstruction and printing

Bolus chase runs can be sent from Philips acquisition systems to the EasyVision system for automatic reconstruction and printing. See Chapter 1, 'Start-up and customizing' about how to set-up the EasyVision system for automatic reconstruction and printing.

Screen layout

To select the bolus chase reconstruction package:

- Click the bolus chase reconstructions button on the package switch panel.

The workstation screen shows the layout for the bolus chase reconstruction package:

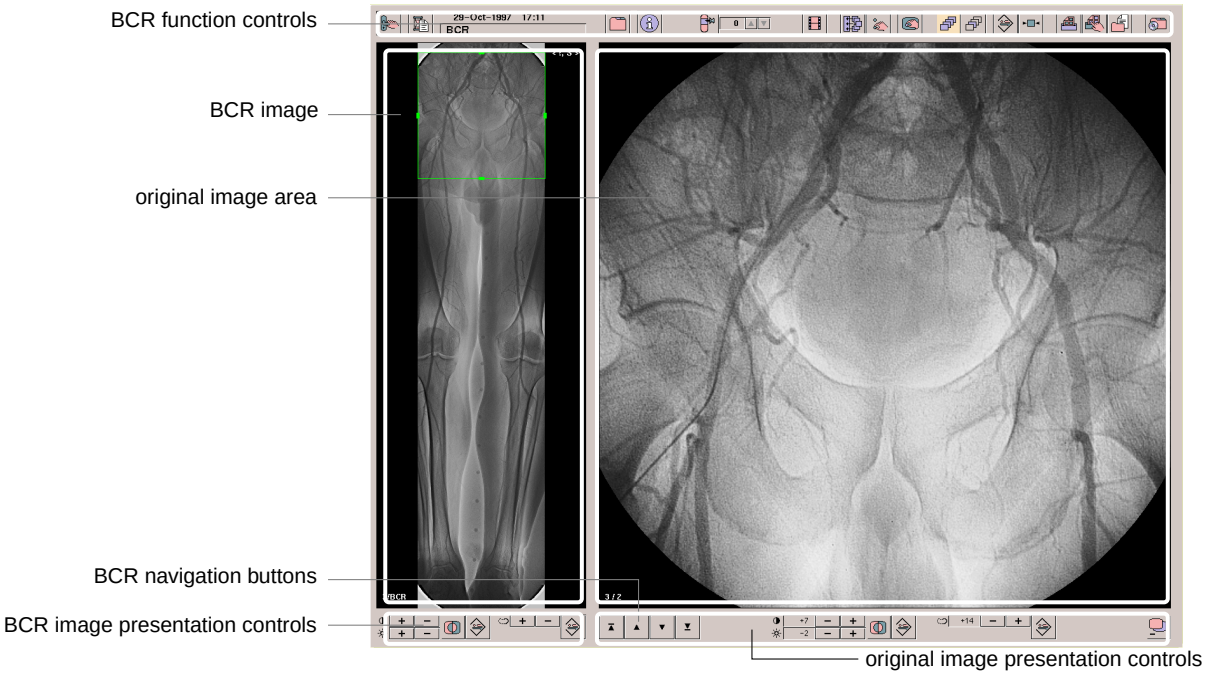


fig.5.1 Bolus Chase Reconstruction screen

The Bolus Chase Reconstruction (BCR) screen is divided in four areas:

– BCR function controls
Here the controls for the BCR functions as well as some auxiliary and general functions are located.

– BCR image
This area shows the reconstructed image. A green square is displayed in the reconstructed image. This square can be used to navigate through the original images and to zoom and pan in an original image.

– Original image area
In this area the original image is shown.

– BCR and original image presentation controls.
Here you will find the controls for contrast / brightness, sharpening etc.

Overview of functions

The top and the bottom part of the screen show the controls to handle the functions of the bolus chase reconstruction package.

BCR function controls

The top row of the screen shows the following controls:

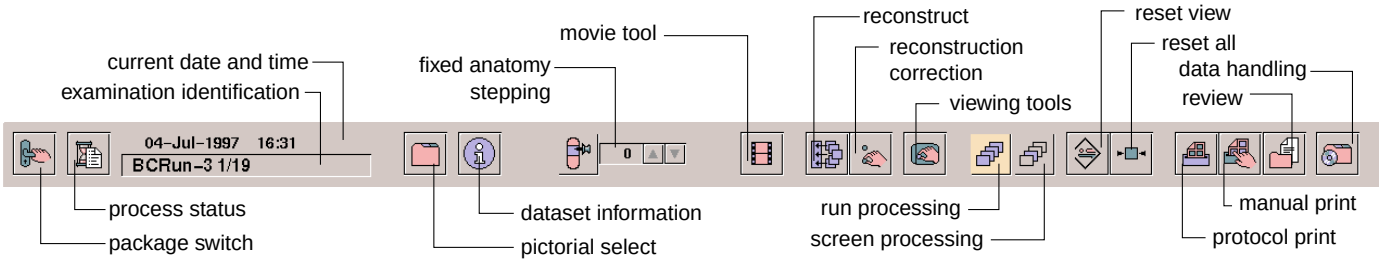
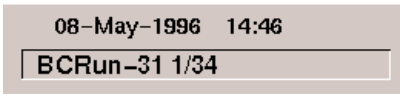


fig.5.2 Top row controls

From left to right the following functions are shown:

– Switch to other package.
To switch from one application package to another and to exit from the EasyVision system.

– Show background process status.
To display status information on the background processes (print, store and communication).

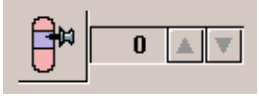


– Current date and time

– Examination identification

– Pictorial select
To select examinations from the database for display.

– Dataset information
To display textual information on examinations.



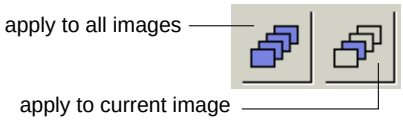
– Fixed anatomy stepping
To step through a bolus chase acquisition series as if the patient is fixed and the images are displayed as a stepping window over the patient.

Movie tool *
To show the original run as a movie.

– Reconstruct
Activates the Bolus Chase Reconstruction function manually.

– Reconstruction correction settings
To change settings for error corrections during reconstruction.

– Viewing tools
Displays a control panel with the following tools: Shutters, Magnifying glass, Calibration, Measurement, Vessel diameter and Annotation.



– Scope of image presentation functions
To apply image presentation functions such as zoom or contrast / brightness adjustment to all images in a run or to the currently displayed original image only.

– Reset view
Resets all viewing parameters such as zoom, contrast / brightness and shutters.

– Reset all
Resets all viewing parameters and the screen layout and removes all other tools from the screen.

– Print Protocol
To print according to predefined print layouts.

– Manual Print Compose
To manually compose a film sheet in a format other than those available in the print layout protocols.

– Compose review folder *
To manually compose a collection of images and comments for later review.

– Data handling short-cuts
To activate frequently used data handling functions without switching to the data handling package.

Functions marked with an asterisk (*) are treated in detail in Chapter 2, ‘Standard functions’.

Image presentation controls

The bottom row of the screen shows the controls for changing the image presentation.

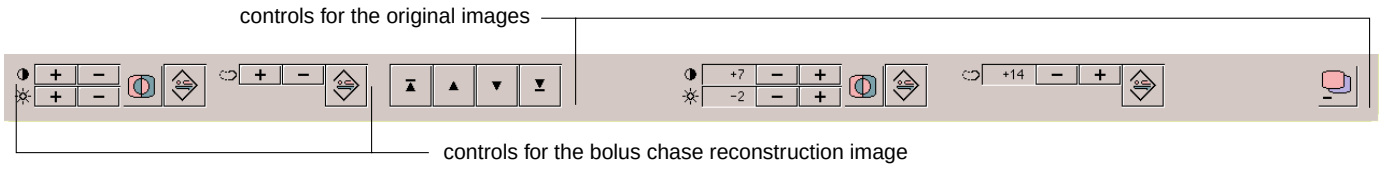
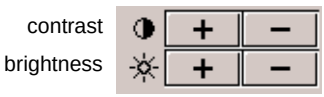


fig.5.3 Bottom row controls

From left to right the following functions are shown:

Controls for the bolus chase reconstruction image



– Contrast / brightness controls - BCR image
To change the contrast and brightness of the BCR overview image.

– Invert grey scale - BCR image
Inverts the grey scale of the BCR overview image.

– Reset contrast, brightness and grey scale invert.
To reset contrast, brightness and grey scale invert to settings as applied at data acquisition.

– Image sharpening controls - BCR image
To sharpen / soften the BCR overview image.

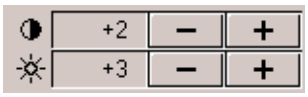
– Reset image sharpening
To reset image sharpening to the setting as applied at data acquisition.

Navigation controls for the original image

– Navigation buttons.
To step through the original images.

Presentation controls for the original image

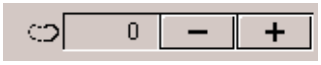
contrast
brightness



– Contrast / brightness controls - original image.
To change the contrast and brightness of the original image(s).

– Invert grey scale - original image(s)
Inverts the grey scale of the original image(s).

– Reset contrast / brightness and grey scale invert - original image(s)
To reset contrast / brightness and grey scale invert to the settings as applied at data acquisition.



– Image sharpening controls - original image(s)
To sharpen / smooth the original image(s).

– Reset image sharpening
To reset image sharpening to the setting as applied at data acquisition.

– Subtract images
To show subtracted images. (Requires preprocessing with the vascular image processing package)

BCR image area

The left image area in the Bolus Chase Reconstruction screen displays a BCR image.

Original image area

The right image area displays a single image from the original bolus chase run. The green navigation square represents the displayed original image on the BCR image.

Image selection and display

Images to be used in the Bolus Chase Reconstruction package should be acquired as bolus chase runs fulfilling the requirements for these acquisitions.

Selecting images

The BCR function will accept any image run selected with the Pictorial select tool. If you select a bolus chase run and its associated reconstruction image does exist, the BCR image is automatically selected and is displayed in the BCR image area with an original image in the image display area. If no BCR image exists, the system will show a confirmation panel to start a bolus chase reconstruction for the selected run.

Begin

To select a bolus chase run:

- Click the Pictorial select button.

The Pictorial select panel appears.

- Select the run that you want to use.

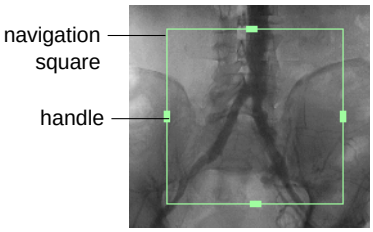
The selected run is now available for reconstruction, viewing and measurements. You may select a complete run or only a part of the run. If you select a run partly, you must select at least 2 images from the run.

End

Navigation

The BCR image area shows the navigation square. With this square you can determine which original image or part of that image will be displayed in the image area.

Begin You can select another image by positioning the navigation square in the following ways:



- Move the cursor to one of the edges of the square (not to one of the handles)
- Drag the navigation square to the required position in the reconstruction image.

  - or -

- Move the cursor to the required position in the reconstruction image
- Left click at this position

  The navigation square will jump to this position with its centre set to the position where you clicked. At or near the top or bottom of the reconstruction image the square jumps to the position corresponding to the first or last original image in the run

End The original image corresponding to the navigation square will be displayed.

Stepping through the run

Begin You can also use the navigation buttons at the bottom of the original image area.

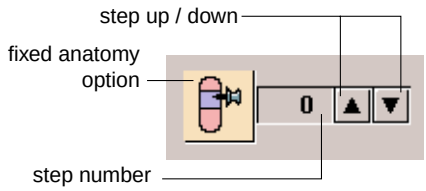
- Click the previous or next button to step one image forward or backward.
- Click the first or last button to jump to the first or last image of the original run.

End The navigation square will be adjusted accordingly.

Fixed anatomy stepping

When using the step buttons, the selected image from the run is presented in the main image display area. Successive clicks on the next or previous button give the impression that the patient shifts through the image panel. As an alternative, successive images can be displayed as if the patient is fixed and the images are displayed as a stepping window over the patient.

Begin



To perform fixed anatomy stepping:

- Navigate to the image with anatomical point of interest.
- Switch on the fixed anatomy stepping option.
- Click the up or down button.

The next or previous image is displayed on the patient's fixed anatomy. The step number is shown relative to the initially selected image.

End

The navigation square

The navigation square represents the part of the image that is displayed in the original image area. Note that this square is displayed on the reconstructed image area, but it determines which part of the **original** image corresponding to the reconstructed image will be displayed in the original image area.
The image can be zoomed and panned in the image display area using the navigation square.

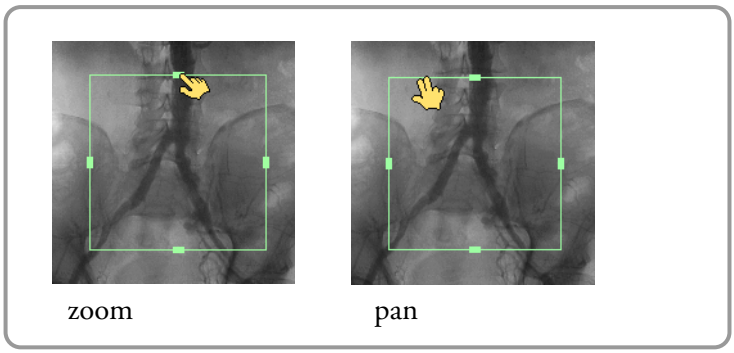


fig.5.4 Zoom and pan with navigation square.

Using the step buttons for navigation through the original images will update the navigation square in the BCR image accordingly.

Zoom and pan control

Begin

To zoom the original image:

- Move the cursor to one of the handles of the navigation square.

- Drag the handle until the navigation square has the required size.

To pan through the original image(s):

- Move the cursor to the navigation square, but do not place the cursor on one of the handles.
- Drag the navigation square through the BCR image.

End The image area will show the corresponding part of the original image.

Scope of image presentation functions

The scope of the contrast / brightness settings and shutter settings on the original image can be changed. There are two options to apply these image presentation settings in the currently selected run.

– Apply to all images in the current run.

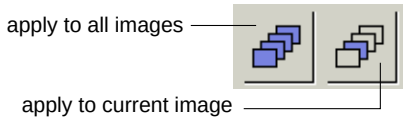
– Apply to the current image only.

The current image is the one displayed in the image area, the current run is the run to which this image belongs.

Note that selecting one of these options itself does not change the image presentation; this option only determines how the image settings will be applied after you have changed the image presentation scope option.

To set the scope of the image presentation controls:

- Click the appropriate option.



Viewing functions

A number of standard viewing and measuring functions can be activated via the viewing tools panel.

To activate the viewing tools panel:

- Click the tool button on the main screen.

The following panel appears:

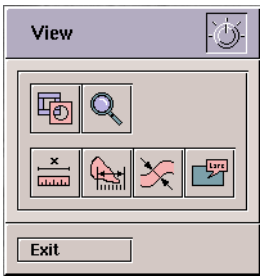


fig.5.5 Display tools panel

The panel shows the buttons to activate the various standard functions.

– Shutters
To set horizontal, vertical and circular shutters.

– Magnifying glass
To magnify the area under the magnifying glass.

– Calibration
For calibration of the original images, using an object of known size. The BCR ruler may be used for this purpose.

– Measurement.
To measure distances, angles etc.

– Vessel diameter
To measure vessel diameter and percentage stenosis.

– Annotation
To add arrows and text to the image.

For convenient use of the calibration tool together with the BCR ruler, the calibration tool shows a preset button for a calibration of 100 mm.

Reconstruct a BCR image

The Bolus Chase Reconstruction is carried out by applying image processing techniques to match subsequent images from a bolus chase run.
The accuracy and the success rate of the reconstruction can be improved by using the BCR-ruler during acquisition. This improves matching of the subsequent images in the run. During a manually started reconstruction, the reconstruction of a new BCR image can be cancelled.

Often a bolus chase run has been sent to the EasyVision workstation with the auto reconstruct request, in these cases the BCR image is already present.If a BCR image is not present, or in case of a reconstruction failure, a new reconstruction can be started.

Begin

To start a reconstruction:

- Click the reconstruct button.

If a BCR image already exists, a confirm panel is displayed, showing the current reconstruction correction settings.

- Click the »Confirm« button to proceed.

During Bolus Chase Reconstruction a progress panel is shown:

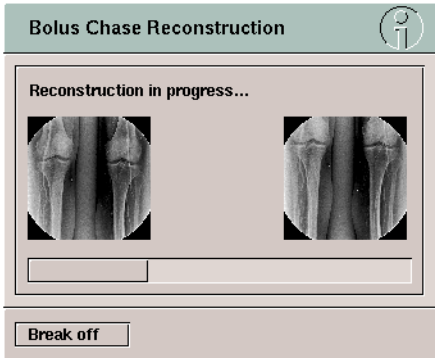


fig.5.6 Bolus Chase Reconstruction progress panel

The Bolus Chase Reconstruction is carried out in two phases. During the first phase the progress panel shows the image pairs for which the translations are determined. During the second phase, the BCR image 'grows' in the BCR image area as the reconstruction proceeds, and the progress panel does not show images.

To cancel the reconstruction in progress:

- Click the »Break off« button.

The new BCR image is stored in the database, if a BCR image existed already, it will be replaced by the new one.

End

Display of subtracted images

In the original image area subtracted images can be shown, provided that you have performed a run subtraction on the bolus chase run. The option to show subtraction images is useful when you start processing a BRC run in the Vascular image processing package and switch to Bolus Chase Reconstruction from the Vascular package.

To show the subtracted images:

- Click the subtraction option switch.

Reconstruction corrections

In some cases the bolus chase reconstruction may not succeed, despite all measures taken to obtain a correct reconstruction image. An unsuccessful reconstruction is indicated in the BCR image with the **<!>** indicator.

You may also conclude that a bolus chase reconstruction was not successful if you observe:

– missing anatomy

– blurred vessels.

Some reasons for these reconstruction failures are:

– Image distortion, especially S-distortion

– Slight disalignment in vertical image direction and longitudinal table movement direction.

These two types of errors may be corrected by applying a rotation to each image before inclusion into the bolus chase reconstruction image.

Correction tool

The image distortion and longitudinal disalignment are acquisition system dependent factors. A correction tool is provided to set the rotation angle and filter option for the acquisition systems which produce bolus chase runs. The correction settings established with this tool can be stored and will be used for all runs originating from the acquisition system for which you have supplied correction settings. You can also apply modified settings before starting a new reconstruction, and store these setting as the new default setting for the acquisition system.

Begin

To activate the BCR correction tool:

- Click the BCR correction button.

The following panel appears:

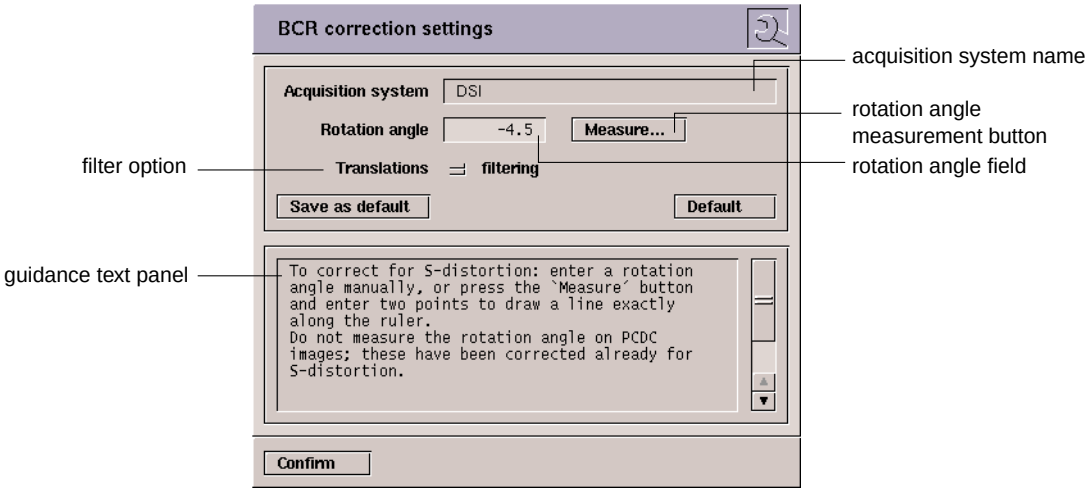

BCR correction settings
Acquisition system
DSI
Rotation angle
-4.5
Measure...
Translations
filtering
Save as default
Default
To correct for S-distortion: enter a rotation angle manually, or press the `Measure´ button and enter two points to draw a line exactly along the ruler.
Do not measure the rotation angle on PCDC images; these have been corrected already for S-distortion.
Confirm
acquisition system name
rotation angle measurement button
rotation angle field
filter option
guidance text panel

fig.5.7 BCR correction settings

In the guidance text field you will find directions about how to use the BCR correction tool.

- Set the required correction angle either by measuring or by manually entering it.
- Set the filter option as required.
- Click the »Confirm« button.

End

Bolus chase reconstruction

Rotation angle

The rotation angle to be used for the bolus chase reconstruction can be set in two ways:

– Enter the rotation angle manually.

– Measure the angle on a test run with the ruler.

A clockwise rotation is given as a positive angle, a counter clockwise rotation is given as a negative angle. Clockwise and counter clockwise rotation is related to the original image as it is displayed in the original image display area.The limits of the rotation angle are +10.0° and -10.0°. (The limits itself are not accepted as rotation angle values.)

Rotation angle correction must not be used for runs that have been processed with the geometric correction function of the Vascular image processing package.

Begin To enter the rotation angle manually:

- Enter the angle in the rotation angle field.
- Click the »Confirm« button.

To measure the rotation angle:

- Select the test run.
- Click the »Measure...« button.
  The cursor changes into a cross-hair.
- Click two points exactly along the ruler.
  The rotation angle is computed and displayed.
- Click the »Confirm« button.

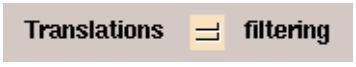
End The rotation angle is now set and you can start a new reconstruction.

Changing the rotation angle will not improve jagged edges of a bolus chase reconstruction image.

Filtering

During reconstruction of the BCR image, for each pair of subsequent images the displacement between these images is computed. These displacements are used to translate the images in the composition of the BCR image. Only small differences in translations for successive images are allowed, the reconstruction may fail in case of an inconsistent displacement. To improve the reconstruction in case of a failure of this type, a median filter can be applied to the translation values.

Begin In case a reconstruction failed due to a translation inconsistency, the displacement values can be filtered before reconstruction:



- Turn on the filter option.
- Click the »Confirm« button.

End The filter option is now set and you can start a new reconstruction.

Default settings

The acquisition system field shows the name of the system which provided the acquired images. You can save the values that you have set as the default values for that system. Any subsequent Bolus Chase Run sent from this system to the EasyVision workstation for automatic reconstruction will be corrected with these correction settings.

Begin To save the correction settings that you have set as defaults for the acquisition system:

- Click the »Save as default« button

If you have changed the correction values, but want to use the previously saved default values:

End
- Click the »Default« button.

Printing images

Images in the BCR package can be printed with the standard EasyVision printing functions. A number of print formats are defined, including formats for printing a single BCR image divided over more than one filmsheet.

Protocol printing

Protocol printing allows routine printing of BCR images according to predefined print formats (or print protocols). The 'Print protocol' function can be used interactively from the EasyVision workstation or remotely from the acquisition system.

In the first case, the standard EasyVision print function is used to select from a list of predefined formats and to start the print job.

In the case of 'remote print', EasyVision can be programmed to automatically reconstruct the BCR image from the run sent by the acquisition system; followed by automatic printing with one of the predefined print formats.

Print compose

The 'print compose' function provides the user with a "pick and place" user interface. An empty preview page with default image locations (frames) is provided.

Using the print functions

Begin

To print images according to predefined print formats:

- Click the Print protocol button.

To compose filmsheets manually:

- Click the Print compose button.

End

Artefacts

BCR is a reconstruction method that calculates an overview image from a series of images. This overview image is intended as a survey image (not as a diagnostic image) and is marked as such with the <S> indicator.

BCR images may contain artefacts if:

– the patient moved during acquisition

– there was excessive tracking displacement between images

Because patient movements cannot be detected automatically it is highly recommended to immobilize the patients legs with straps.

Excessively large tracking steps can be signalled by EasyVision because it estimates step-size. Ensure that the tracking steps are sufficiently small. If they exceed a limit of 65 pixels, the system displays a warning at the end of the reconstruction and a <**!**> sign is shown in the reconstructed the image. If the distance between tracking images exceeds 100 pixels, the reconstruction is terminated at that location and started again at the next location, producing a clear gap in the BCR image.

Image distortion

The following sections describe the known types of image distortion and how to limit them.

Pincushion distortion

Pincushion distortion is caused by the curvature of the input-screen of the image intensifier - this type of distortion is therefore most serious near the edges of an image. For BCR, only the vertical distortion matters, since all images are acquired along the longitudinal patient axis. The effects of pincushion distortion can be minimized by ensuring that there is a large degree of overlap between images. A combination of smooth movement and high frame rate is required.

Parallax errors

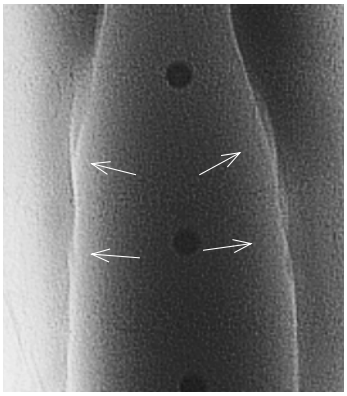
Parallax errors are caused by the divergent nature of the X-ray beam. As a result, object shape changes with view point, e.g. overlap between vessels. These effects show up in the direction of translation, and their size is related to the size of the tracking step between images. The effects of parallax distortion can be limited by keeping the displacement between consecutive images as small as possible. This can be achieved by combining a slow, smooth tracking movement with a high frame acquisition rate.

Catheters and guide wires are likely to cause parallax artefacts when present in the image area. It is advisable to keep them out of the field of view therefore.

Lateral movement

Lateral movement of the table during acquisition causes reconstruction artefacts, because the BCR algorithm assumes a longitudinal movement of the table only. Thus any lateral movement of the table must be avoided.

Jagged edges



jagged edges

The bolus chase reconstruction image may exhibit jagged edges to a more or less extent. This phenomenon is caused by the fact that the reconstruction algorithm in the first place attempts to align the vascular structures in subsequent images. In this process the image may be adapted in width to align left and right leg vascular structures. Due to the varying height difference between the vessels and the skin edges and the parallax deformation of the images, the skin edges may not be aligned properly, although the vascular structures are perfectly matched. The change of shape of the image band added to the reconstruction image causes the jagged edges. The current implementation of the BCR algorithm does not correct for parallax distortion.
The jagged edges artefact is often more pronounced with images from obese patients; in these cases the difference in height of the skin and the vessels is larger. Consequently the parallax deformation is more serious in these cases.

Reconstruction image quality indicators

The image quality indicators are shown on the reconstructed image at the top right hand corner, if applicable.

The Bolus Chase Reconstruction image serves as a survey image and it is not to be used for diagnostic purposes. Always refer to the original X-ray images for clinical diagnosis.

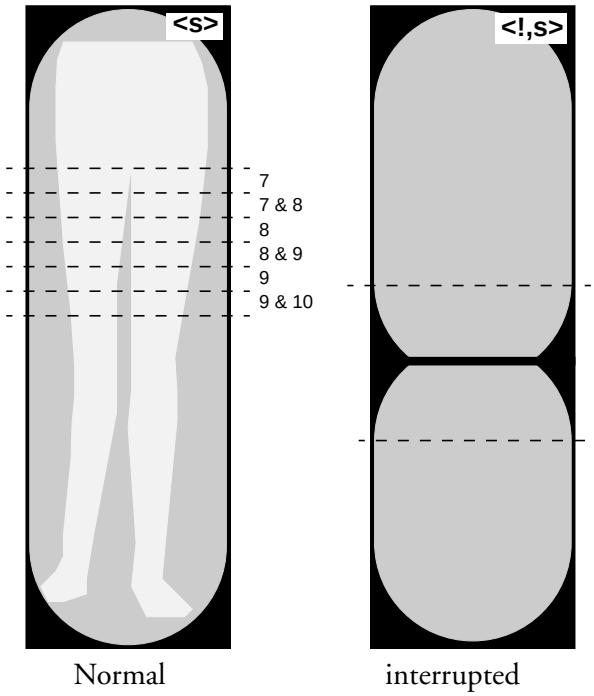
EasyVision provides image quality indicator and reconstruction reliability indicator with a Bolus Chase Reconstruction image both on screen and on film.

The following indicators are used in BCR images:

– **S** - “survey image” indicator
Indicates that a BCR image is a Survey image. This indicator is displayed with all BCR images.

– **!** - “limited reliability” indicator
This indicator is only displayed when the bolus chase reconstruction image may contain artefacts due to excessive table displacement between X-ray images.

Normal reconstruction. Narrow bands from original images build up the BCR image. Overlap-band between e.g. 8 and 9 is indicated as ‘8 & 9’.



Interrupted reconstruction
No fit found at location P. Remainder of last image is partly shown. Reconstruction is resumed at Q. Part of first image is shown.

fig.5.8 Bolus Chase Reconstruction image indicators

Chapter 6

Leg measurements

Introduction

The leg measurements package is designed for measurement of lower limb geometry.
The package reconstructs a single composite image from a run of X-Ray images made for this purpose.

This composite image is then used for length and angle measurement.

The composite image can be printed, with or without measurement graphics and annotations, on film, thermic paper or paper for easy archiving and viewing.

The algorithm for leg composite image reconstruction is specifically designed for a series of images of the lower limb skeleton. It takes specific features of these images into account. It must not be used for reconstruction of other types of images.

Colon overview images, spine or bolus chase reconstruction images must be reconstructed with the appropriate packages.

Acquisition of images for leg measurements

The X-ray images used for leg measurements are made with the patient in standing position. AP projection is preferred, but PA projection is also possible. The special ruler supplied by Philips Medical Systems with the leg measurements package is positioned between the patient's legs. The image of the ruler is used during the reconstruction of the composite image.

If the image of the ruler coincides with the image of some internal or external leg or bone fixation part or device or prostheses, reconstruction of the composite image may fail.

The following equipment can be used to acquire the images for leg measurements:

– Multi Diagnost 3 or 4 with Digital Spot Imaging.

– Diagnost 94, 96, or 97 with Digital Spot Imaging.

The equipment must be connected to an EasyVision RAD workstation with the leg measurements package installed.

Acquisition protocols

To obtain images suitable for a reliable reconstruction of a composite leg overview image, an appropriate acquisition protocol should be used. The following recommendations must always be considered for an acquisition protocol.

Recommendations

– Always use the special rule supplied by Philips Medical Systems with the Leg measurements package. This ruler is specifically designed for reconstruction and calibration purposes.

– Position the ruler as close to the leg boners as possible, but without overlapping the leg bones.

– For one leg reconstructions: position the leg in the centre of the image (to reduce the influence of geometrical distortion) and the ruler as close as possible to the leg.

– Traction apparatus, prostheses and direct radiation filters can disturb the image reconstruction process if they have a high contrast and if they are in a different plane than the patient's legs with respect to the image intensifier. Moreover, they can disturb the ruler detection. Successful reconstruction cannot be guaranteed in these cases.

– Always use the largest source to image intensifier distance possible.

Suggestions for an acquisition protocol

Locally, system configurations, as well as user preferences may differ, and therefore cause reasons to deviate from the suggested protocol.

Stand:

- Table in +90° position.
- Source-Image distance: 1.5 m.
- X-Ray tube angulation 0°.
- Speed of Tube/Image intensifier with respect to patient: 4 or 6 cm/s
- Collimator rotation 0°.
- Collimate 50% in vertical direction (with respect to the patient).

Image Intensifier:

- Select the maximum image intensifier format.

DSI:

- Select dose: half dose (± 50 µR / image).
- Select 2 or 3 images/s (2 in case of 4 cm/s, 3 in case of 6 cm/s)
- Select the 512^2 matrix for a regular scan.

Images with a 512^2 are recommended; transfer and processing times for 1024^2 images are considerably longer than those for 512^2 images.

Generator:

- Select a proper kV value.
- The exposure time should be short, ± 5 ms (or less, adjust kV if necessary).

Exposure run:

- Position the patient in an upright position. Instruct the patient not to move, the composite image may show movement artefacts. Be sure that you only use longitudinal movement during the scan.
- Position the ruler supplied with the leg measurements package between the patients legs.

System positioning to acquire images for leg measurements

Diagnost 94, 96, 97

The Diagnost 94, 96, 97 - system is positioned in an upright position (+90 degrees), with the footrest attached at approximately 40 cm from ground level. The patient is in the standing position, with back against the tabletop.

fig.6.1 Diagnost 97 with Digital Spot Imaging.

Multi Diagnost 3, 4

The Multi Diagnost 3, 4 - system is positioned minus 90 degrees table tilt, with the second footrest attached at approximately 40 cm from floor level; patient is in the standing position, facing table-top, edges of patients heel(s) are situated at the edges of the footrest; image intensifier is positioned at a minimal distance from the patient considering anatomy.

.

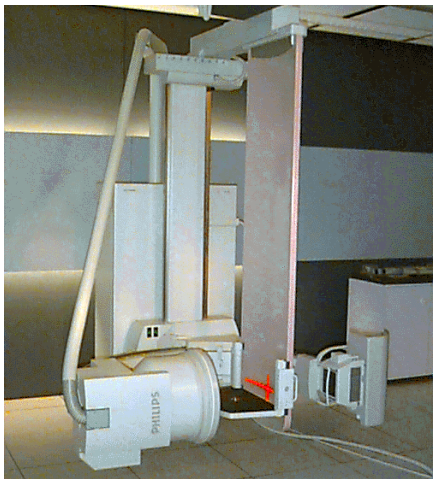


fig.6.2 Multi Diagnost 4 with Digital Spot Imaging.

Finishing image acquisition

After data acquisition with your system, proceed as follows:
Procedure on DSI:

Keep all images of the run(s) that you have taken.

- Send the entire exposure run to the EasyVision workstation through function key F2 'EV send'.
- Delete images / runs on the DSI only after all images have been stored in the EasyVision database.

Philips acquisition systems and non-Philips acquisition systems which are not mentioned here have not been validated for use with the EasyVision leg measurements package.

Philips Medical Systems does not take any responsibility for unsatisfactory results due to use of acquisition systems other than those mentioned above.

Overview of buttons

The top and the bottom row of the screen contain the control buttons of the leg measurements package.

The top row shows the following controls:

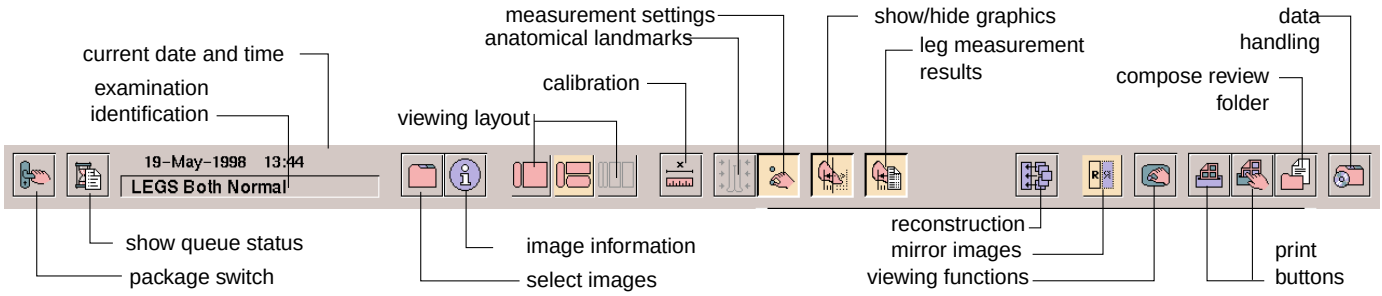
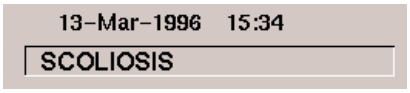


fig.6.3 Top tool bar.

The buttons perform the following functions (from left to right):

– Package switch.
For switching from one EasyVision package to another.

– Show queue status.
For inspecting the status of background processes.



– Current date and time.
Examination identification.

– Select images.
This button opens the pictorial selection tool.

– Image information.
For obtaining dataset information.

– Screen layout.
Use these buttons to select the appropriate viewing mode for measurements or review.

– Calibration.
Used to calibrate the image before length measurements.

– Defining anatomical landmarks.

– leg measurements settings.

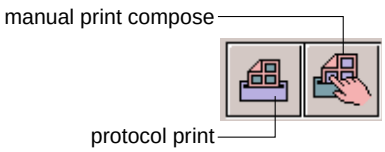
– Show / hide graphics.

– Display results of leg measurements.

– Reconstruction.
To start a new reconstruction of a composite image, (if the first reconstruction was not satisfactory for example).

– Mirror images
Displays images inverted from left to right.

– Viewing functions.
Four viewing functions are available.



– Print functions.
The manual print compose function is available in all EasyVision RAD packages, the protocol print function is available only when the EasyPrint package is installed.

– Compose review folder.
For manual composition of a collection of images and comments for later review.

– Data handling short-cuts.
Used to copy, store on optical disk and remove images without switching to the data handling package.

The bottom toolbar contains the following controls:

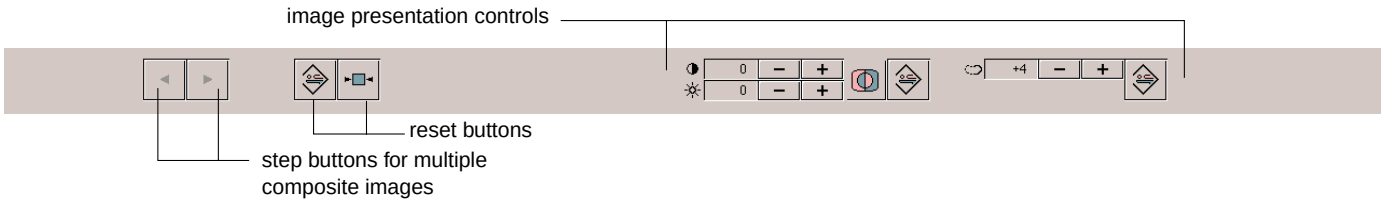
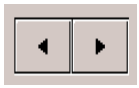
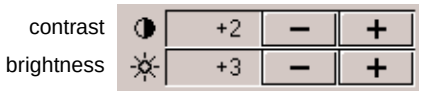


fig.6.4 Bottom toolbar.

From left to right the following functions are shown:



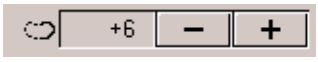
– Navigation.
To step through a number of composite images for review and comparison.



– Image contrast and brightness.
Increase / decrease contrast and brightness.

– Inverse video.
To invert the black / white display of images.

– Reset contrast / brightness.
Resets contrast / brightness to original settings.



– Edge enhancement.
To sharpen / smooth the images.

– Reset edge enhancement.
Resets edge enhancement to settings used during data acquisition.

Start leg measurements

To select the leg measurements package:

- Click the leg measurements button on the package switch panel. This opens the leg measurements screen:

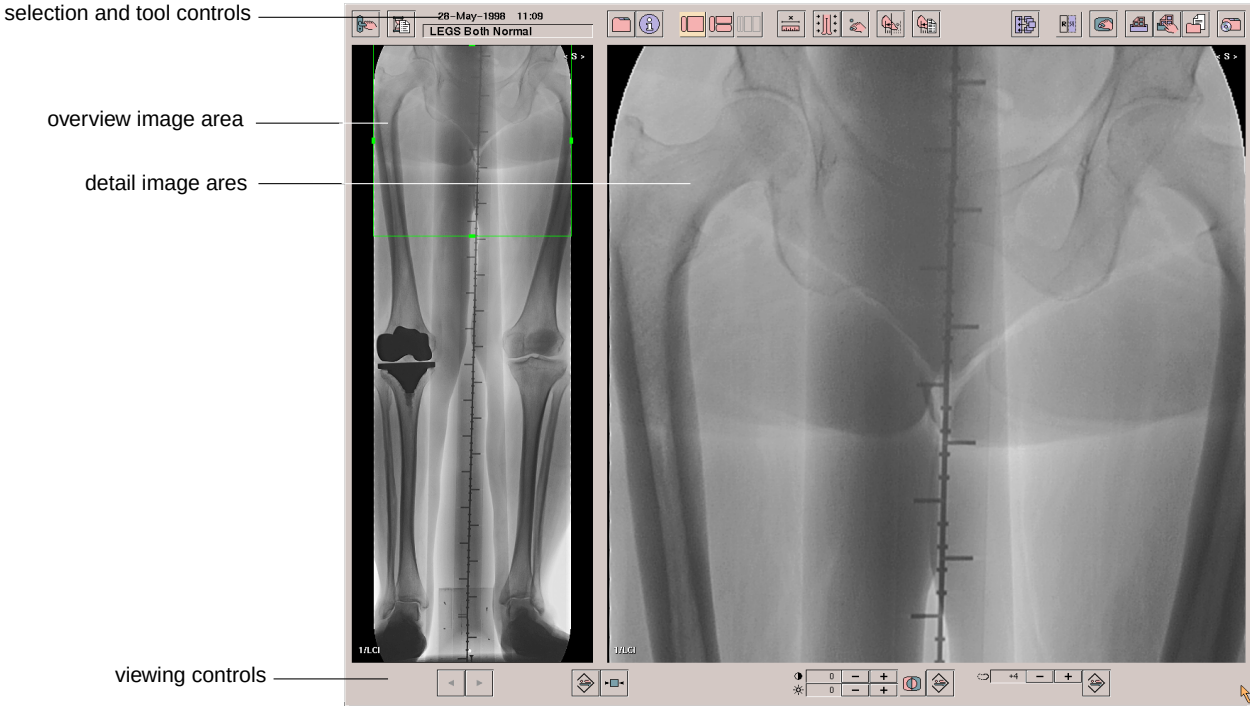


fig.6.5 leg measurements screen.

The controls for data selection, reconstruction, evaluation and printing of the composite images are located at the top of the screen. The bottom toolbar contains the step buttons to navigate through a number of composite images selected for viewing and the controls for image presentation.

The screen is split into two windows, the left window is used to display the composite image (the overview area) and the right window is used to display details of the composite image or original images (the detail image area).

Reconstruction of a new composite image

Newly imported series of images have no composite image. Proceed as follows to reconstruct a composite image from the new series of images: First select the images for reconstruction:

- Click the pictorial select button.

The pictorial select panel appears. See Chapter 5, 'Standard functions' how to select images with pictorial select.

- Select only the run that you want to use for reconstruction.

After selection of a single run for which no composite image exists, the reconstruction starts automatically. A confirm panel appears:

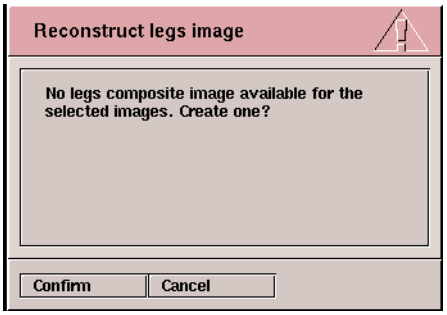


fig.6.6 Confirm new reconstruction.

- Click the »Confirm« button to proceed.
- The reconstruction options panel is displayed.

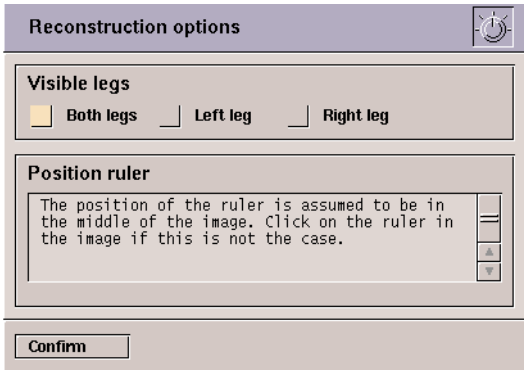

Reconstruction options
Visible legs
Both legs
Left leg
Right leg
Position ruler
The position of the ruler is assumed to be in the middle of the image. Click on the ruler in the image if this is not the case.
Confirm

fig.6.7 Selection panel for reconstruction options.

- In the 'Visible legs' panel, select one of the following:
  - Both legs,
  - Left leg or
  - Right leg.

Because the leg measurements package can be used to measure on images displaying both legs or one leg only, the position of the ruler may not be inside the middle of the image.

If the ruler is not exactly in the middle of the image, its position must be marked by the user. Only when the ruler is positioned exactly in the middle of the image, this marking is not necessary.

The accuracy of the leg measurements results depends on the ruler position.

Image intensifier distortion is not corrected for.

- Click »Confirm«
  The reconstruction starts and the progress panel is displayed:

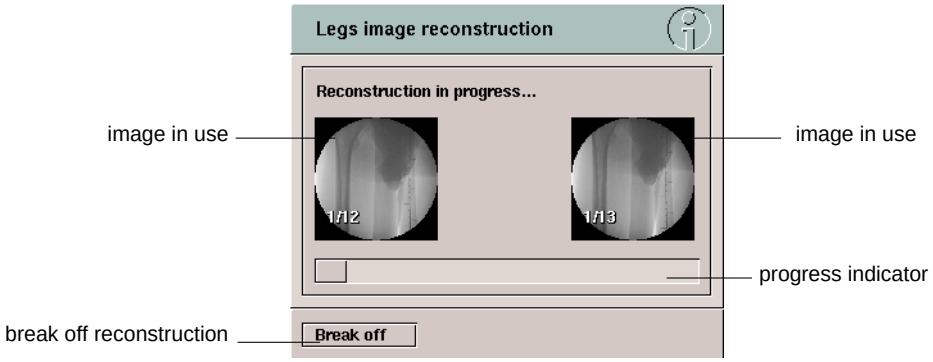


fig.6.8 Reconstruction progress panel.

Reconstruction progress

The composite image is reconstructed in two stages:

– In the first stage the image series is analysed to determine whether the images are suitable for reliable reconstruction of a legs composite image. The progress panel displays the pair of images for which the distance shift is being computed and the number of images processed.

– In the second stage only the number of images processed is shown, and you can see the composite image growing in the composite image area of the screen.

When the reconstruction is complete, the composite image is displayed in the composite image area and the detail area. A successfully reconstructed image is automatically stored in the database together with the original images.

Break off reconstruction.

Reconstruction of a composite image can be stopped by clicking the »Break off« button.

Partly reconstructed images are not stored in the database.

Replacing a composite image

You may wish to repeat a reconstruction when the initial reconstruction failed or was unsatisfactory. The old composite image is replaced by the new one.

First select the images for the new reconstruction:

- Click the pictorial select button.
  The pictorial select panel appears. See Chapter 5, 'Standard functions' for how to select images with the pictorial select tool.
- Select only the run that you want to use for reconstruction.
  You may select the complete run or a part of it, but you must always select a number of consecutive images. If a previous reconstruction failed or was unsatisfactory, it may be useful to select only that part of the run which produces a correct composite image.

- Click the reconstruction button.
  A confirmation panel appears:

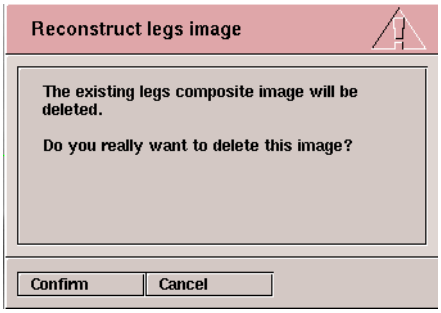

Reconstruct legs image
The existing legs composite image will be deleted.
Do you really want to delete this image?
Confirm
Cancel

fig.6.9 Confirm to replace the existing reconstruction.

- Click the »Confirm« button to proceed - the existing composite image is cleared:
- The reconstruction options panel is displayed again. Select the required visible legs option, (both legs, left leg or right leg) and mark the position of the ruler if this is not positioned exactly in the middle of the image.
- Click "Confirm" to start the reconstruction. The progress panel is displayed again.
- When the reconstruction is complete, the composite image is displayed in the composite image and the detail area.

The new image replaces the old composite image in the database.

Calibration

Before calibration, measurements are expressed in arbitrary units.

After the calibration, measurements are displayed in mm.

Use the ruler in the image for calibration. The distance between the large marks on one side of the ruler is 50 mm. Angle measurements can be made without calibration. You may calibrate an image before or after you have added anatomical landmarks.

- Click the calibration button to calibrate the image.

Correct calibration is validated with the ruler supplied by Philips Medical Systems with the Leg measurements package. Calibration with other methods is the users responsibility.

Accuracy

Calibration on the (central) ruler is accurate for *vertical* measurements on the patient's legs.

Calibration on the (central) ruler is accurate for *horizontal* measurements on the patient's legs as far as they are sufficiently parallel to the image intensifier *Horizontal* measurements on the patient's legs for points far from the centre of the image intensifier are inaccurate due to geometrical distortion.

Leg measurements settings

- Click the measurement settings button in the upper toolbar to select which leg measurements should be made.

The 'Leg measurement settings panel' is displayed:

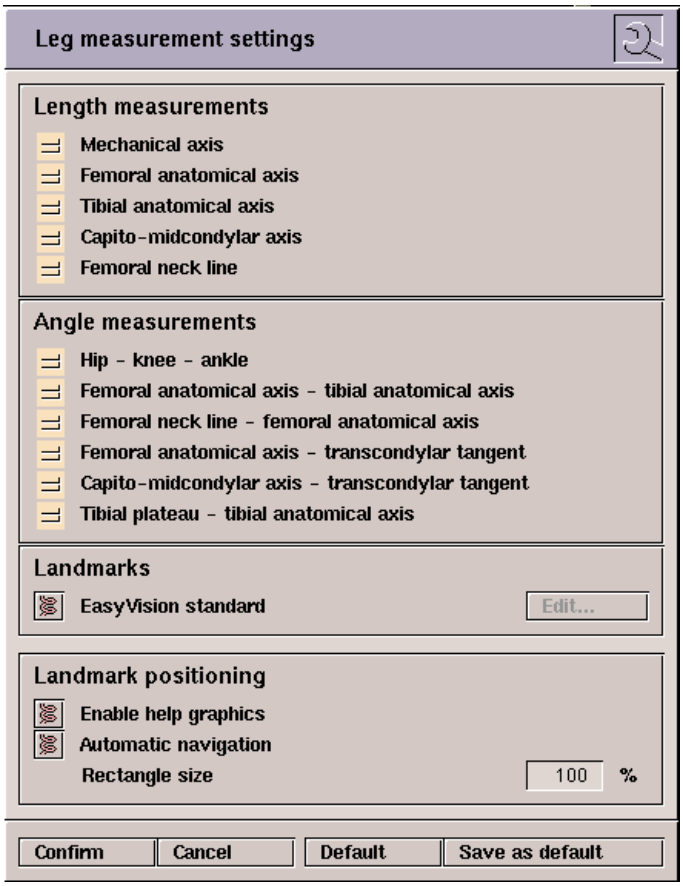


fig.6.10 Leg measurements settings panel.

The panel is divided in four sections:

1. *Length measurements*

2. *Angle measurements*.

3. *Landmarks*:

   Use standard EasyVision landmarks or use alternative landmarks.

4. *Landmark positioning*:

   – Enable/disable help graphics: Help graphics guide the anatomical landmark positioning.

   – Automatic navigation: Moves the navigation rectangle to the likely position of the selected anatomical landmark.

The settings selected in this panel can be confirmed or cancelled, or chosen as default settings. The panel can also be used to select the current default settings.

Anatomical landmarks

A number of special, well-defined anatomical landmarks have to be set before the leg measurement results can be generated.

- Click the anatomical landmarks button.

The anatomical landmarks panel is displayed.

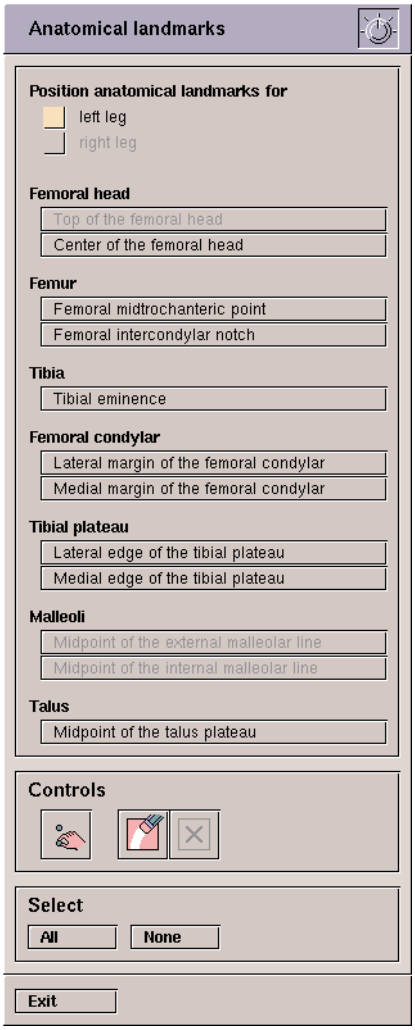


fig.6.11 Anatomical landmarks panel.

This panel is used to position the anatomical landmarks for the selected leg angle and leg measurements.
Only those landmarks required for the measurements selected in the 'Leg measurement settings' panel are enabled. The other landmark buttons are greyed-out and cannot be activated.

– If both legs are to be measured, these landmarks must be defined for both right and left leg.

- Select the leg that you want to start with

- Select the first landmark that you want to define.
  The corresponding part of the image is displayed. If help graphics and automatic navigation is enabled with the 'Leg measurement settings' panel, the help-graphics are shown as well

If the anatomical orientation is not yet established, the 'Anatomical orientation' panel appears:

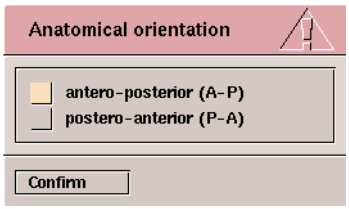


fig.6.12 Selection panel for anatomical orientation.

- Select the anatomical orientation (A-P) or (P-A).

It is the users responsibility to set the correct A-P or P-A orientation of the acquisition, since the Left/Right orientation is derived from this selection.It can not be derived from any other information. Philips Medical Systems takes no responsibility for incorrect use of this function.

- Select the next landmarks until all landmarks required for the measurements are defined.

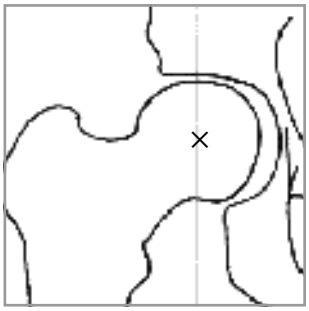
Repeat the procedure for the second leg (if both legs are present in the same composite image).

- Click left mouse button on the image, but not on a landmark.
  If there are measurements associated with landmarks already entered, lengths and angles are displayed.

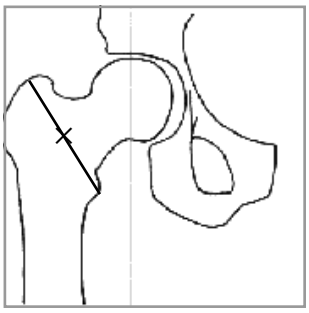
Leg measurements

Landmarks available

– Femoral head: Top of the femoral head.

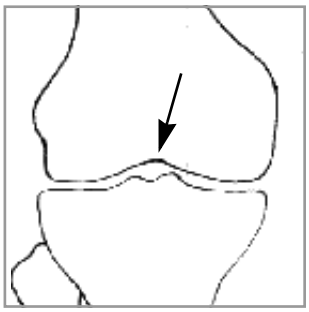


– Femoral head: Centre of the femoral head.



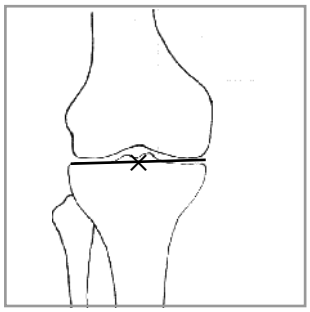
– Femur: Femoral midtrochanteric point.

  Situated at the midpoint of the line joining the trochanter major and trochanter minor.

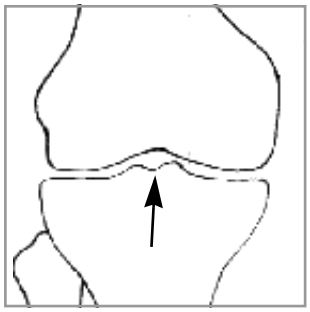


– Femur: Femoral intercondylar notch.

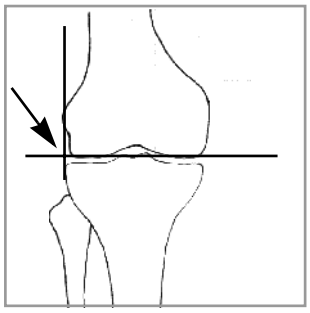
  Situated at the most proximal point of the femoral intercondylar notch region.



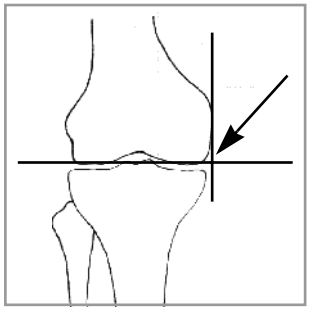
– Tibia: Tibial - eminence,
Situated at the midpoint of the line joining the tibial spines,



- or -
Situated at the most distal point between the tibial spines.



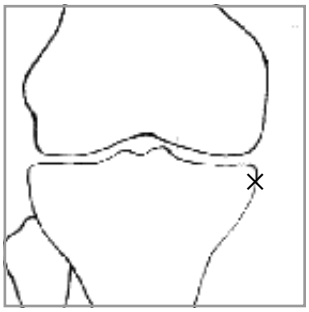
– Femoral condylar: Lateral margin of the femoral condylar.
Situated at the perpendicular intersection of the transcondylar tangent and the margin at the most lateral point of the posterior condyles (osteophytes are not included).



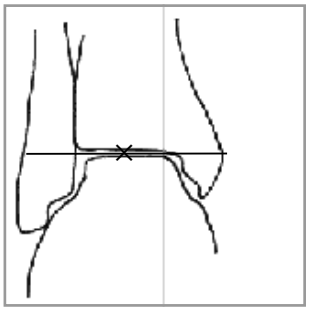
– Femoral condylar: Medial margin of the femoral condylar.
Situated at the perpendicular intersection of the transcondylar tangent and the margin at the most medial point of the posterior condyles (osteophytes are not included).

– Tibial plateau: Lateral edge of the tibial plateau.
Situated as the most lateral point of the tibial plateau.

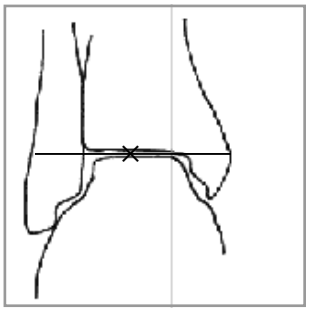
Leg measurements



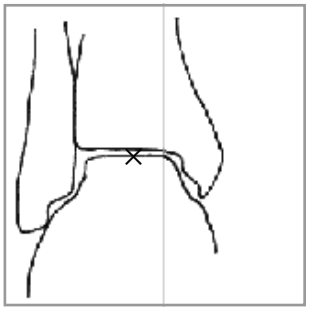
– Tibial plateau: Medial edge of the tibial plateau.
Situated as the most medial point of the tibial plateau.



– Malleoli: Midpoint of the external malleolar line,
Situated at the midpoint of the line joining the external edges of the malleoli at the height of the cartilaginous space.



– Malleoli: Midpoint of the internal malleolar line.
Situated at the midpoint of the line joining the internal edges of the malleoli at the height of the cartilaginous space.



– Tallus: Midpoint of the talus plateau.
Situated at the midpoint of the line joining the cartilaginous plateau margins of the talus.

Handling landmarks

At the bottom of the 'Anatomical landmarks' panel, the following controils are located:

Change grapic properties

- Used for changing the colour setting and width of the lines.

Undo / delete

- Undo the last change to the landmarks.

- Delete the selected landmarks.
  Measurement associated with a deleted landmark are removed as well.

You may redefine deleted anatomical landmarks.

You may select one or more landmarks with left or middle mouse clicks, or use the »All« or »None« buttons in the 'Select' section of the 'Anatomical landmarks' panel.

- Click "All" to select all landmarks.
- Click "None" to deselect all landmarks.

Landmarks and measurements behave as standard EasyVision Graphic objects.

Leg measurement results

- Click the button to obtain the leg measurement results.
  The following panel is displayed:

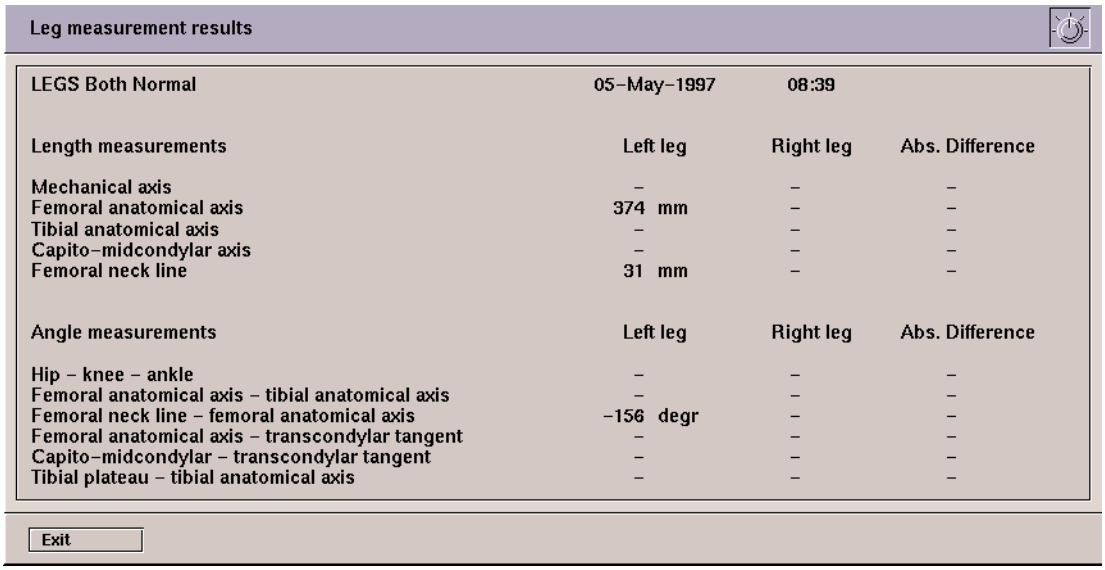

Leg measurement results
LEGS Both Normal
05-May-1997
08:39
Length measurements
Left leg
Right leg
Abs. Difference
Mechanical axis – – –
Femoral anatomical axis 374 mm – –
Tibial anatomical axis – – –
Capito-midcondylar axis – – –
Femoral neck line 31 mm – –
Angle measurements
Left leg
Right leg
Abs. Difference
Hip – knee – ankle – – –
Femoral anatomical axis – tibial anatomical axis – – –
Femoral neck line – femoral anatomical axis -156 degr – –
Femoral anatomical axis – transcondylar tangent – – –
Capito-midcondylar – transcondylar tangent – – –
Tibial plateau – tibial anatomical axis – – –
Exit

fig.6.13 Leg measurement results panel.

The results are listed if they have been selected in the 'Leg measurement settings' panel and if the correct anatomical landmarks have been entered.

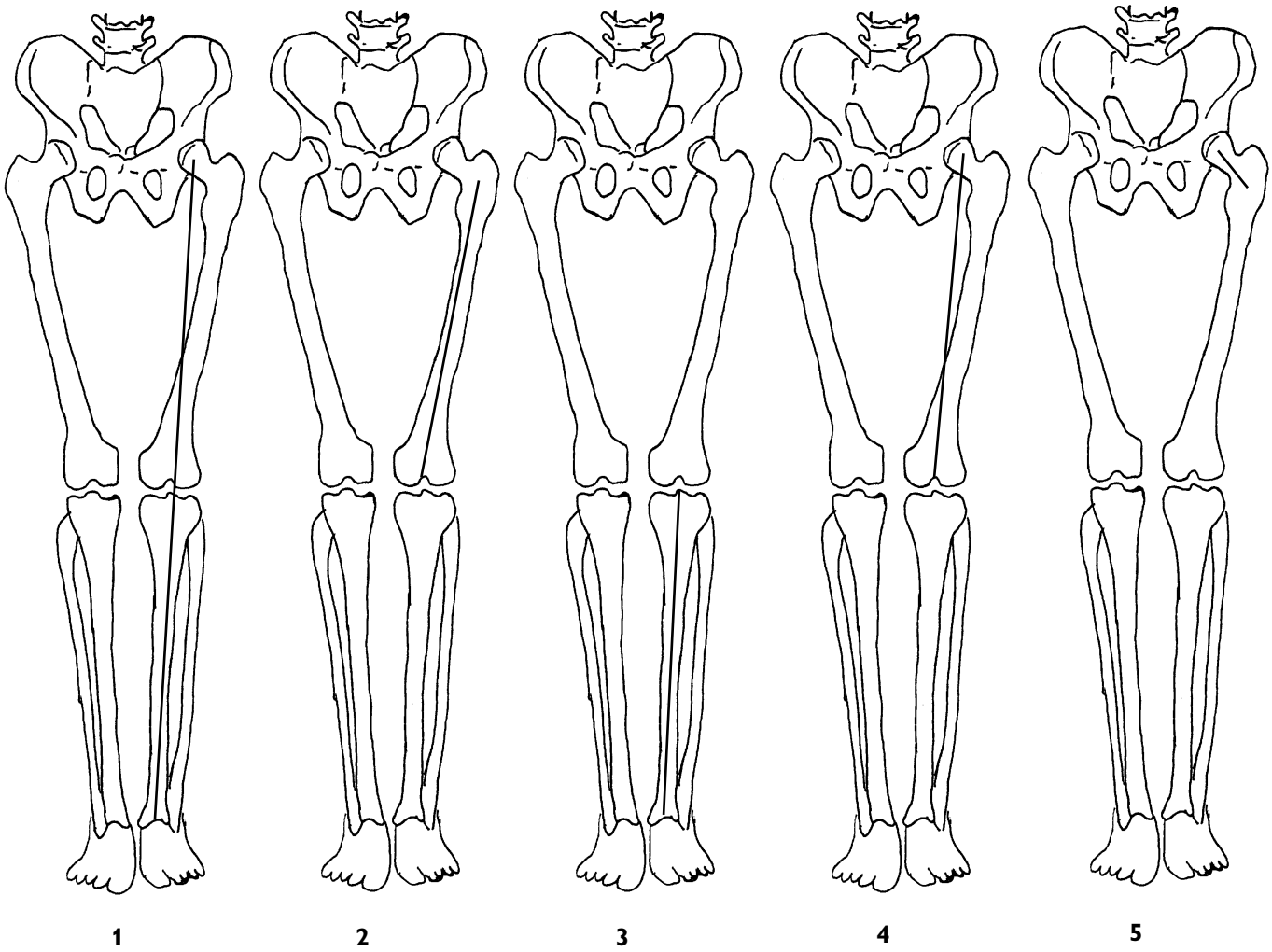
For one leg scanning the 'Leg measurements results' panel shows:

– length(s) in mm
– angles in degrees

For two leg scanning in addition:

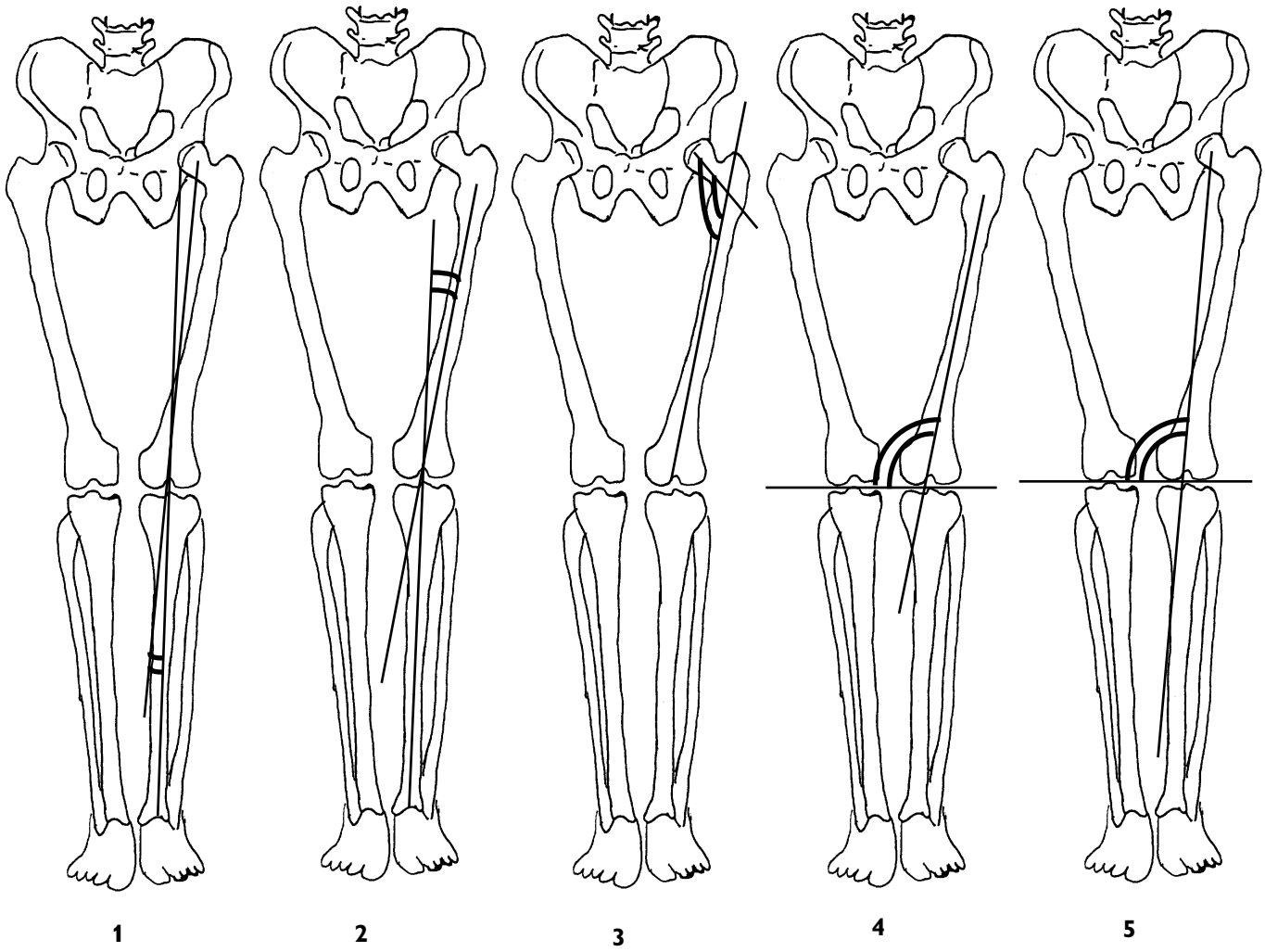
– length differences in mm
– angle differences in degrees.

Length measurements



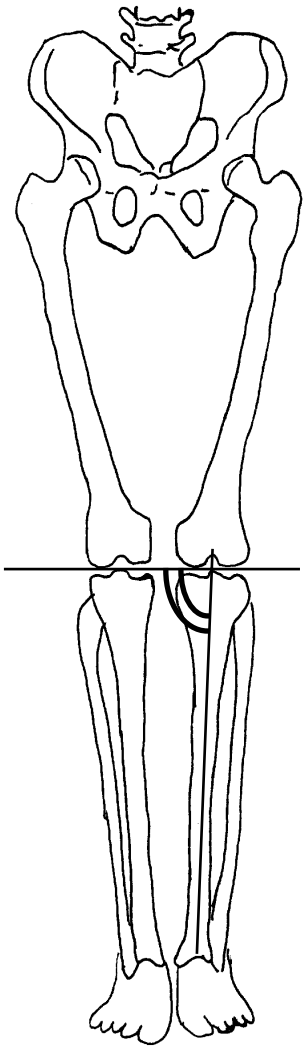
1. Mechanical axis: Distance between the femoral head and the midmalleolar point.
2. Femoral anatomical: Distance between the femoral midtrochanteric point and the femoral intercondylar notch.
3. Tibial anatomical axis: Distance between the midtibial eminence and the midmalleolar point.
4. Capito midcondylar axis: Distance between the femoral head and the femoral intercondylar notch.
5. Femoral neck line: Distance between the femoral head and the midtrochanteric point.

Angle measurements



1. Hip - knee - ankle: Angle between the capito-midcondylar axis and tibial anatomical axis.
2. Femoral anatomical axis - tibial anatomical axis: Angle between the femoral anatomical axis and tibial anatomical axis.
3. Femoral neck - femoral anatomical axis: Angle between the femoral neck line and femoral anatomical axis.
4. Femoral anatomical axis - transcondylar tangent: Angle between the femoral anatomical axis and the femoral transcondylar tangent.
5. Capito-midcondylar - transcondylar tangent: Angle between the capito-midcondylar axis and femoral transcondylar tangent.

6. Tibial plateau - tibial anatomical axis: Angle between the tibial articular marginal line and the tibial anatomical axis.



6

Image attributes

Clicking the right mouse button shows the image “Attributes” panel. This is used to mark images for special printing or to prevent them from automatic deletion.

fig.6.14 Image attributes pop-up panel

To mark images for special printing:

- Turn on the ‘Special image’ option to mark a single image for special printing
- Turn on the ‘Special run’ option to mark all images of the run for special printing.

To protect images from automatic deletion:

- Turn on the ‘Protect’ option.

Review of images and measurements

– The standard pictorial select tool is used to select images from the database.

To review existing composite images, select one or more leg composite images from the database. Images can also be selected from the original run. When original images are selected, the program automatically finds and displays the related composite image.

- Select 'Single' screen layout to view a single composite image and a large detail area. The detail area shows a part of the composite image.

- Select 'Single and original' screen layout to view a single composite image, a detail of the composite image and the original image corresponding to the detail image.

- Select 'Compare' screen layout to compare two composite images.

The measurements already made on these images can be edited.

You can only edit the measurements in the leg measurements package, they are not visible in any other packages running on your EasyVision workstation.

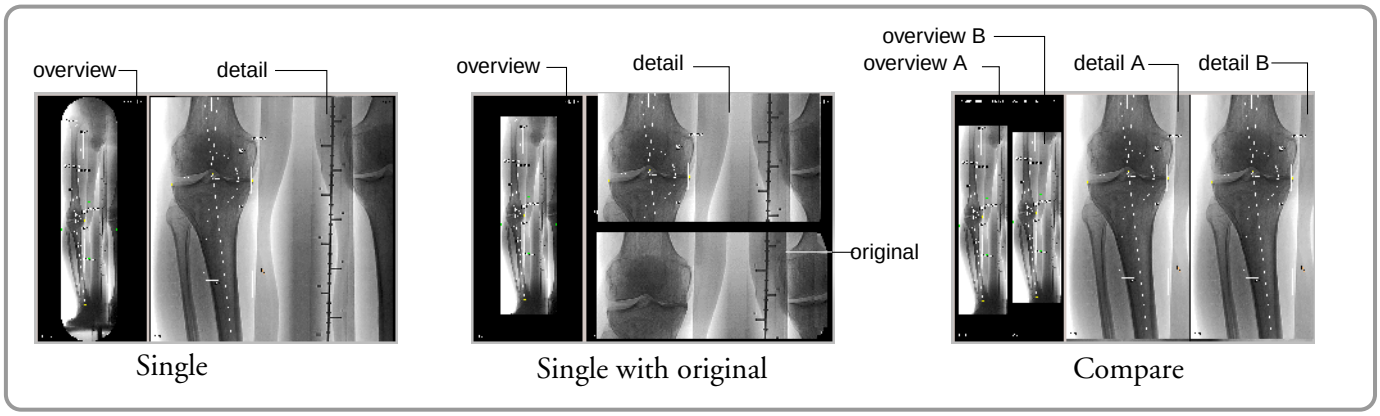


fig.6.15 Screen layouts.

Hide graphics

You can temporarily hide graphical objects. This is useful for inspecting the position of anatomical landmarks and also for printing images on film without landmarks and measurements when using "Manual print compose".

- Click the hide graphics button to temporarily hide the measurement objects on the composite image.

Navigating through the composite image

The detail area shows a part of the image displayed in the composite area. The green rectangle in the composite image area represents the part of the composite image that is displayed in the detail area. This rectangle can be used to control which part of the composite image is shown in the detail image.

In 'Compare' screen layout, there is a control rectangle on both composite images. A green rectangle on the left image, a red rectangle on the right image.

Use of the green rectangle to select an image is describe below, the red rectangle is used in the same way.

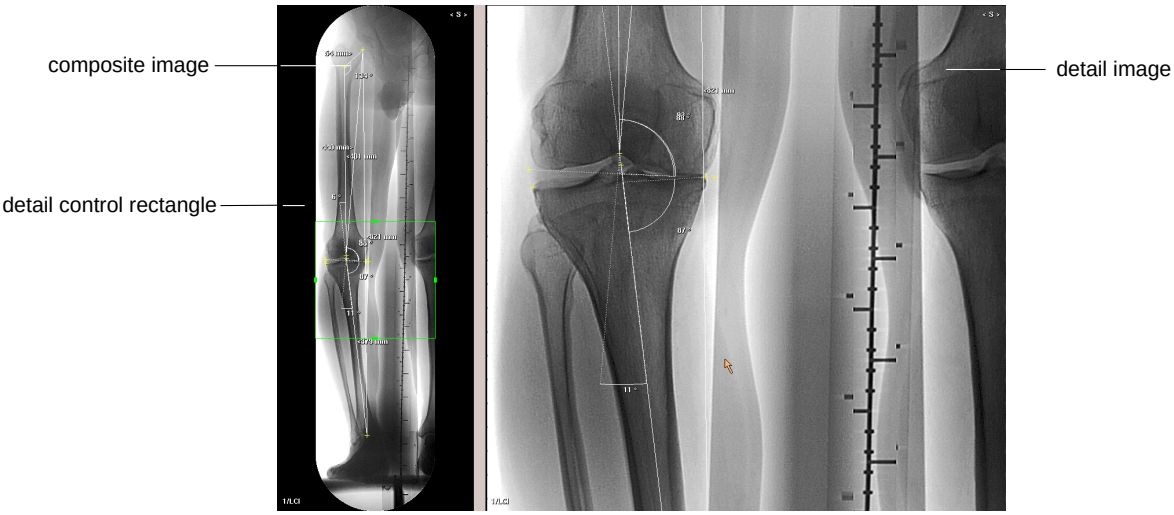


fig.6.16 Navigating through images.

Zoom

Each side of the green rectangle has a small green square, or 'handle'.

To change the enlargement of the detail image:

- Drag the control rectangle by one of its handles.

The rectangle changes symmetrically in size and on release of the mouse button the detail image is updated to show the part of the composite image inside the control rectangle.

Pan

The green rectangle can be used to determine which part of the composite image is shown in the detail image.

To display another part of the composite image as the detail image:

- Drag the control rectangle by one of its sides (but not by a handle)

On release of the mouse button the detail image is updated to show again only the part of the composite image inside the control rectangle.

- or -

- Move the cursor in the composite image to the position required to be the centre of the detail image.
- Left click at this position.

The control rectangle in the composite image jumps to the new position and the detail image is updated accordingly.

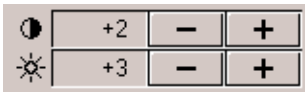
Image presentation

The appearance of the image can be changed with the contrast / brightness controls, the edge enhancement controls, and the inverse video button at the bottom of the screen.

Contrast / brightness

To change contrast and brightness:

contrast
brightness



- Click the appropriate '-' or '+' button.

To reset the contrast and brightness to their original setting:

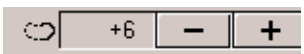
- Click the reset button.

To invert the black / white display of the images:

- Click the inverse video button.

Edge enhancement

To apply edge enhancement for increased visibility of details:



- Click the '-' or '+' button.

To reset edge enhancement to its original setting:

- Click the reset button.

When used with 'single' composite image or 'compare' layout, the contrast / brightness, inverse video, edge enhancement, and the shutter controls act on the composite images.

For the 'single and original' image layout these controls act on the original image only.

The image settings are stored in the database and will be applied to images when these are retrieved from the database.

Change left / right orientation

The left / right orientation of the displayed images can be changed to suit the preferred left / right display convention.

To change the left / right orientation of the images:

- Click the mirror option switch.

The mirror setting is not stored in the database. When the images are subsequently retrieved from the database, they will be displayed with original image orientations.

If the mirror option switch is on, the changed orientation is also applied to printed images.

If the mirror option switch is on, an image orientation symbol is displayed in the lower right hand corner of the images. This symbol is displayed on the screen images as well as on printed images.

Viewing functions

– Click the viewing functions button to select one of the four viewing functions.
The View selection panel appears:

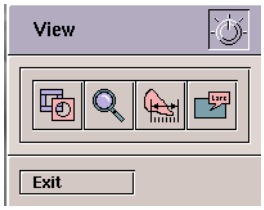


fig.6.17 Viewing functions.

– Shutters.
Shutters can be used on the composite image. This is especially useful for hiding the white background.

– Magnifying glass.
The magnifying glass can be used on the composite area as well as on the detail area.

– General purpose tools.
To measure distance, angle and areas.

– Annotation.
Images can be annotated with the standard annotation function.

Printing images

Leg composite images can be printed on film with the manual print compose function, and if the EasyPrint package is installed, predefined film layouts can be used.

Protocol print

The protocol print function offers the following predefined layouts:

– One composite image
– The same composite image twice on one film, with or without measurement graphics.
– Two different composite images on one film.
– One composite image with originals.

To print with a predefined layout:

• Click the protocol print button.

The protocol print panel appears:

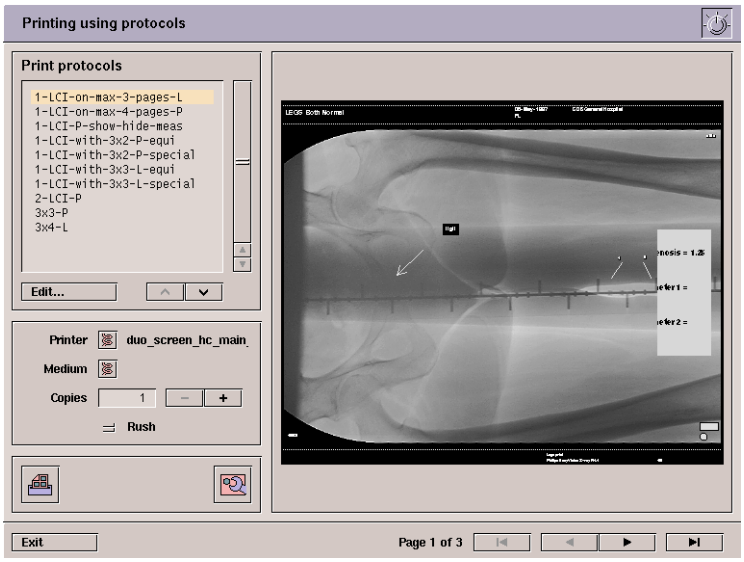


fig.6.18 Protocol print panel.

See Chapter 7, ‘Printing’ for how to print images and how to use the protocol print function.

Manual printing

To print with the manual print compose function:

- Click the print compose button.

The print compose panel appears. See Chapter 7, 'Printing' about how to use this print function.

- Compose each film as it is needed.

Data flow in the leg measurements package

Data flow in the leg measurements package is illustrated below:

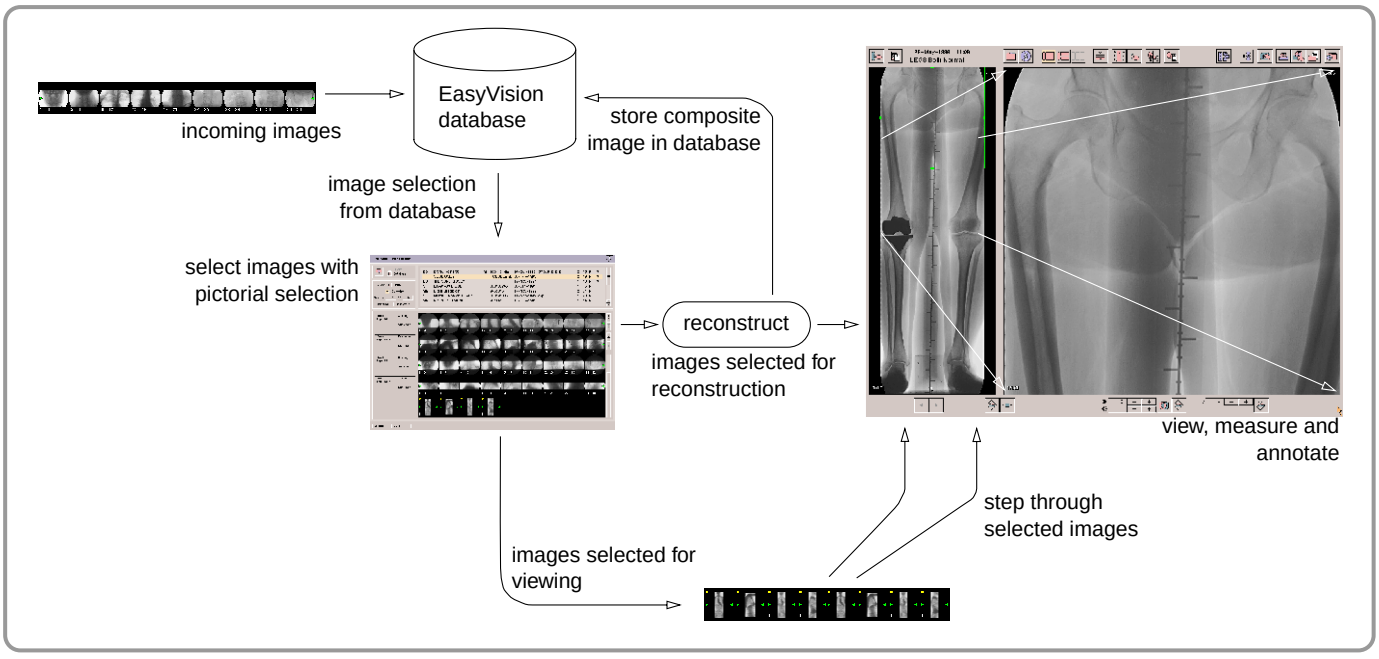


fig.6.19 Overview of leg measurements package.

Chapter 7

Spine image reconstruction

Introduction

The spine reconstruction package is designed for the assessment of patients with scoliosis. With this package a single composite image is reconstructed from a series of X-Ray images especially taken for this purpose. This composite image can be used for the evaluation of gross anatomy and measurements. On these images the Cobb's angle of the curve(s), vertical alignment of the spinal column and the height difference of the femur heads can be measured. Composite images can be compared for follow-up purposes. Furthermore these images can be printed with or without measurement graphics and annotations on standard film for easy archiving and demonstration.

The algorithm for spine image reconstruction is specifically designed for a series of images of the spine acquired with a prescribed acquisition protocol. It takes specific features of these images into account. Therefore it should never be used for reconstruction of other types of images nor should other measurements be made than for which it is designed.

No attempt should be made to use the spine image reconstruction package for the reconstruction of an overview image of the legs and taking measurements from such a reconstructed image.
Colon overview images or bolus chase reconstruction images must be reconstructed in the appropriate packages.

Acquisition protocols for spine imaging

To construct a reliable composite image, a well defined protocol must be followed. The algorithm used to reconstruct a spine composite image assumes that the correct acquisition protocol has been used. At reconstruction of the image it is not possible to check whether all requirements are met; it is the user's responsibility that a spine composite image is composed only from runs that have been produced with the correct protocol.

We have defined such protocols for the following equipment:

– Multi Diagnost 3 or 4 with Digital Spot Imaging.

– Diagnost 94, 96, or 97 with Digital Spot Imaging.

The equipment must be connected to an EasyVision RAD workstation with the spine reconstruction package installed.

The requirements for data acquisition to compose a spine composite image are described separate application notes.

After data acquisition with your system, proceed as follows:

Procedure on DSI:

- Keep all images of the run(s) that you have taken.
- Send the entire exposure run to the EasyVision workstation through function key F2 'EV send'.
- Delete images / runs on the DSI only after all images have been stored in the EasyVision database.

See Chapter 1, 'Start-up and customizing about how to set up Automatic reconstruction and printing.

Philips acquisition systems and non-Philips acquisition systems which are not mentioned here have not been validated for use with the EasyVision Spine image reconstruction package.

Philips Medical Systems does not take any responsibility for unsatisfactory results in case of use of other acquisition systems and / or other acquisition protocols than the above mentioned.

Spine image reconstruction

To select the spine reconstruction package:

- Click the spine button on the package switch panel.

The workstation screen shows the layout for the spine reconstruction package:

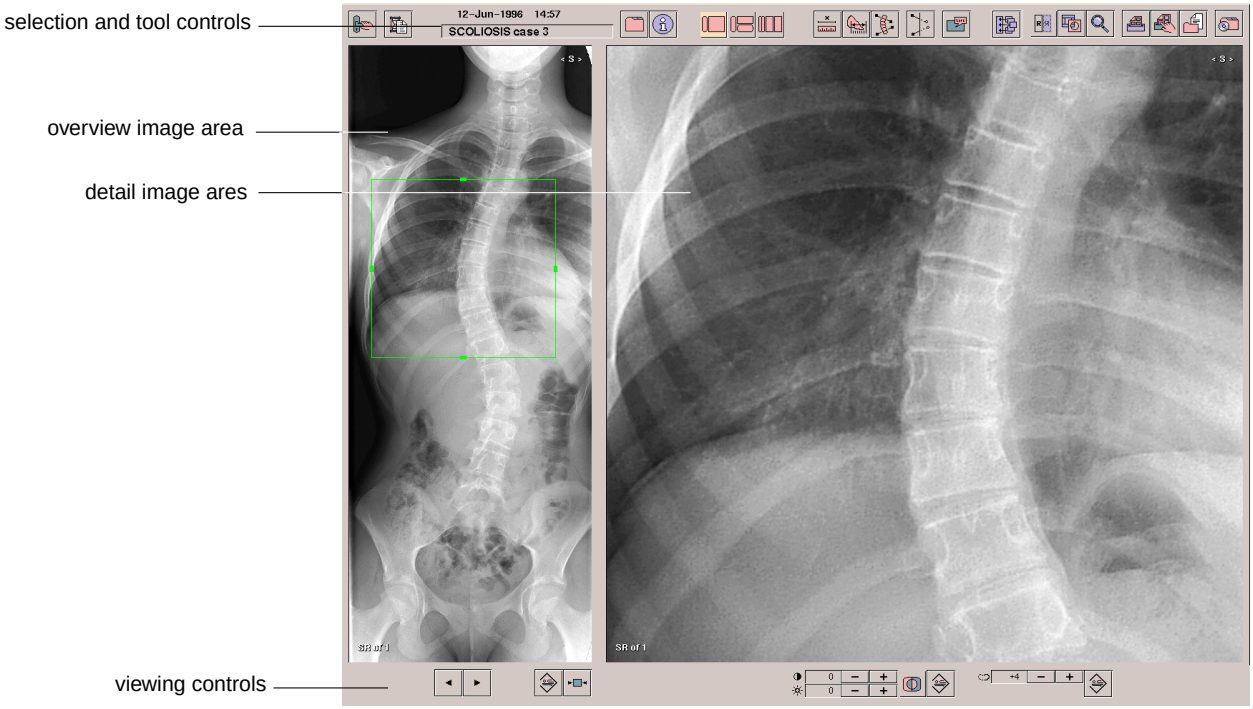


fig.7.1 Spine package screen layout

The controls for data selection, reconstruction, evaluation and printing of the composite images are located at the top of the screen. The bottom part shows the step buttons to navigate through a number of composite images selected for viewing and the controls for image presentation.

The large part of the screen that is available for image display is split into two parts, the left hand part is used to display the composite images (the composite image area) and the right hand part is used to display details of the composite image or original images (the detail image area).

Overview of functions

The top and the bottom part of the screen show the controls to handle the functions of the spine reconstruction package.

The top row of the screen shows the following controls:

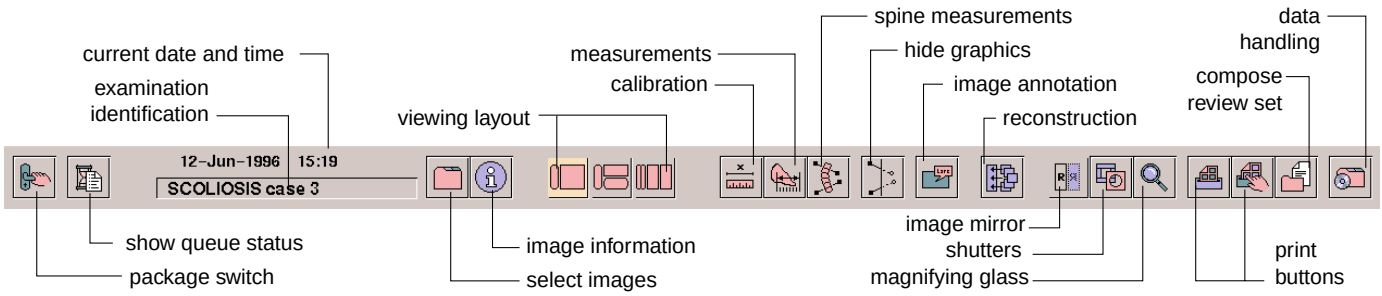
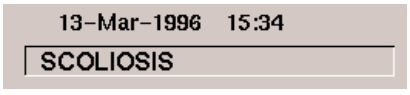


fig.7.2 Top row controls

From left to right the following functions are shown:

– Package switch
To switch from one EasyVision package to another.

– Show queue status.
The status of background processes can be inspected with this function.



– Current date and time.
– Examination identification.

– Select images.
This button activates the pictorial selection tool.

– Image information.
Dataset information can be obtained with this function.

– Screen layout.
Select with these buttons the appropriate viewing mode for measurements or review.

– Calibration.
Use this function to calibrate the image for distance measurements.

– General purpose tools.
To measure distance, angle and areas.

– To measure Cobb's angle, vertical alignment and femur head height difference.

– Hide graphics.
To temporarily hide measurement graphics from the image for better visibility of anatomical details.

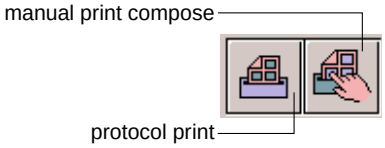
– Annotation.
Images can be annotated with the standard annotation function.

– Reconstruction
To start a new reconstruction of a composite image, e.g. incase the first reconstruction was not satisfactory.

– Mirror images
Mirror the images displayed, i.e. exchange left and right sides of the images.

– Shutters.
You can apply shutters to the composite image. This is especially useful to hide the white background.

– Magnifying glass.
To activate the magnifying glass. Can be used on the composite area as well as on the detail area.



– Print functions.
Buttons to activate the print functions. The manual print compose function is available in all EasyVision RAD workstations, the protocol print function is available only when the EasyPrint option is installed.

– Compose review folder
To compose manually a collection of images and comments for later review.

– Data handling short-cuts
To copy, store on optical disk and to remove images without switching to the data handling package.

The bottom row of the screen shows the following controls.

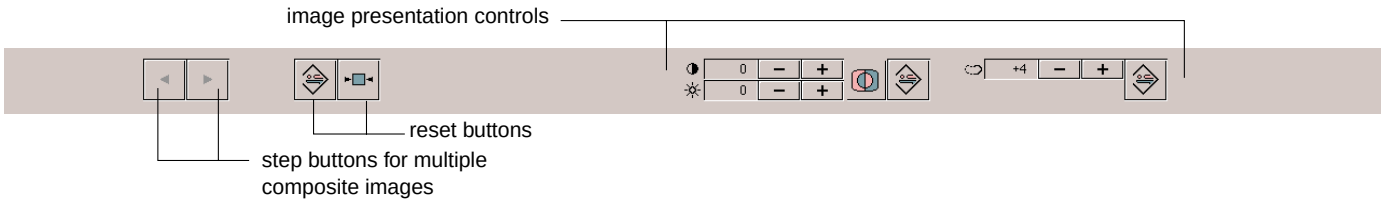
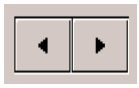
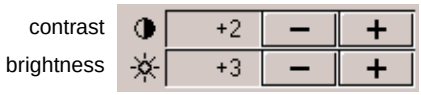


fig.7.3 Bottom row controls

From left to right the following functions are shown:



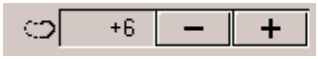
– Navigation.
Buttons to step through a number of composite images for review and comparison.



– Image contrast and brightness
Increase / decrease contrast and brightness.

– Inverse video
To invert the black / white display of images.

– Reset contrast / brightness
Resets contrast / brightness to original settings.



– Edge enhancement
To sharpen / smooth the images.

– Reset edge enhancement.
Resets edge enhancement to settings as applied at data acquisition.

Spine package overview

The following figure depicts the spine image reconstruction package:

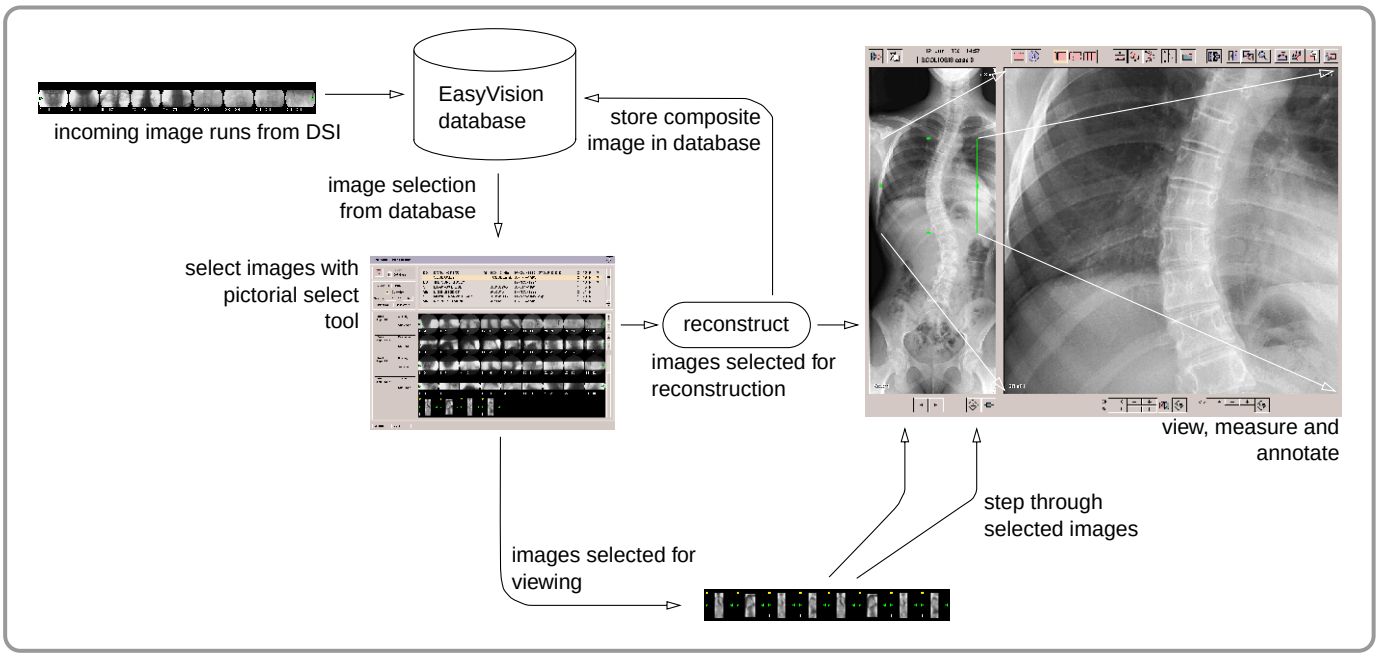


fig.7.4 Overview of package

There are basically two modes of working with the spine reconstruction package.

1. The reconstruction of a spine composite image from a series of images and preparation for review.
2. Review of one or more spine composite images which have already been reconstructed.

Image selection

To select images from the database you have to use the standard pictorial selection tool.

For the reconstruction of a new composite image you must select only one run that is imported into the EasyVision database for spine reconstruction.

For review of composite images you can select one or more spine composite images from the database. You can either select images from the original run or the reconstructed image itself, the program recognizes the relation between the original data and its reconstructed image and will automatically select the composite image.

Reconstruction and preparation for review

For the initial reconstruction and to prepare for review the following steps must be taken:

Begin

- Select from the database the run from which you want to reconstruct a composite image.
- Start the reconstruction.
- Perform the measurements as required for the evaluation of the condition of the patient.
- If desired, move image graphics away from details which must remain visible.
- Annotate the image if required.
- Send images to the printer according to a predefined protocol if required and / or store these images on optical disk.

End

Review of images and measurements.

You can review a single composite image, or compare composite images. Reconstructed composite images can be reviewed as follows:

Begin

- Select one or more composite images from the database.
- Select viewing layout 'Single' for the inspection of a single composite image on a large detail area.
- Select viewing layout 'Double' for comparison of successive composite images.
- Select viewing layout 'Single and original' for inspection of a single composite image and its relation to the original image.

You can modify measurements already done on these images.

You can modify the scoliosis measurements in the spine reconstruction package only, they are not visible in other packages of your EasyVision workstation.

Reconstruction of a new composite image

For a newly imported series of images no composite image exists yet. To obtain a composite image from this series of images, proceed as follows:

Begin

First select the images for reconstruction:

- Click the pictorial select button.

The panel for the pictorial selection tool will appear.

- Select the run that you want to use for reconstruction.

After selection of a single run for which no composite image exists yet, the reconstruction will start automatically. A confirm panel appears:

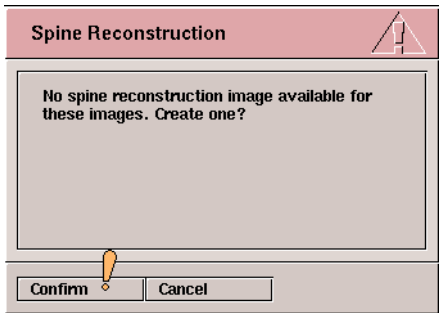


fig.7.5 Confirm new reconstruction

- Click the »Confirm« button to proceed.

The reconstruction starts and the reconstruction progress panel appears.

After the reconstruction has been completed the composite image is displayed in the composite image area and the detail area. A successfully reconstructed image is stored in the database together with the original images.

End

Replace a composite image

You can also start a reconstruction again with a run for which a composite image already exists. You might wish to do so in case the reconstruction failed or was questionable. The old composite image will be replaced by the newly reconstructed image.

Begin

First select the images for reconstruction:

- Click the pictorial select button.
- Select only the run that you want to use for reconstruction.

You may select the complete run or select a part of the run, but you must select a number of consecutive images. Selection of a limited run may be useful if a previous reconstruction failed or was questionable. Select in this case that part of the run which produces a correct composite image.

- Click the reconstruction button.

A confirm panel appears, the existing composite image is removed when you proceed:

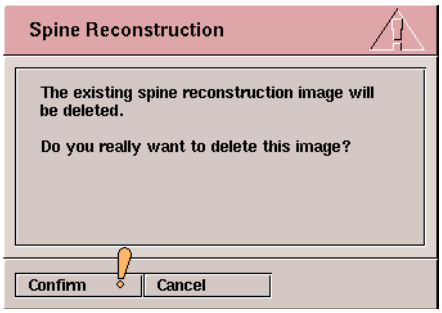

Spine Reconstruction
The existing spine reconstruction image will be deleted.
Do you really want to delete this image?
Confirm
Cancel

fig.7.6 Confirm reconstruction

- Click the »Confirm« button to proceed.

The reconstruction starts and the progress panel appears.
After the reconstruction is completed, the composite image is displayed in the composite image and the detail area.

End

Reconstruction progress

The reconstruction of a spine composite image is divided into two phases. During the first phase of the reconstruction the image series is analysed whether the images are suitable for reliable reconstruction of a spine composite image or not. During the second phase the images are merged into the composite image.

When you start the reconstruction of a composite image, a progress panel appears:

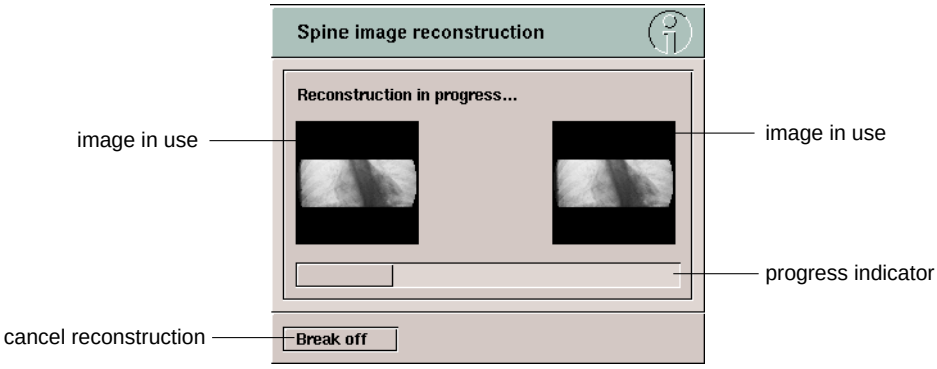


fig.7.7 reconstruction progress panel

During the first phase of the reconstruction the progress panel shows the pair of images for which the distance shift is computed, and the number of images processed is shown. During the second phase only the number of images processed is shown, and you can see the composite image growing in the composite image area of the screen.

Cancel a reconstruction.

Begin You can cancel the reconstruction of a composite image.

To do so:

- Click the »Break off« button.

End An incomplete reconstructed image is not stored in the database.

Artefacts

Spine image reconstruction is a method that calculates a composite image from a series of images. This composite image is intended as a survey image, as such it is marked with the <**S**> indicator. The spine image reconstruction algorithm is designed to allow measurements on the spine composite image.

Causes of artefacts

spine composite images may contain artefacts if:

– The patient moved during acquisition.

– The patient breathed too strong during acquisition.

– There was too much displacement between images.

Patient movement

Because patient movement cannot be detected automatically, you are advised to instruct the patient very well to stand still and to hold the handgrips.

Patient breathing

Excessive breathing of the patient can be avoided by instructing the patient to breath slowly and superficially.

Large steps

Excessively large steps between successive images can be signalled by the spine image reconstruction algorithm because it estimates step size. The step size can be too large if the correct acquisition protocol has not been followed.

Artefact indication

If artefacts are detected, a warning is displayed at the end of the reconstruction and a <!> sign is added to the descriptive data displayed with the image. The location of the artefact(s) is indicated by horizontal lines in the composite image.
If the distance between successive images is extremely large, a clear gap is produced in the image and another warning is displayed at the end of the reconstruction.

Image distortion

Due to the image formation with an X-Ray beam, which consists of divergent rays, and the physical properties of the image intensifier the following image distortions can be recognized:

– Pincushion distortion

– Parallax errors

Furthermore due to the nature of the spine image reconstruction image distortion can be cased by:

– Lateral movement

Pincushion distortion

Pincushion distortion is caused by the curvature of the input screen of the image intensifier; this type of distortion is therefore greatest near the edges of an image. For spine image reconstruction, only the vertical distortion is considered, since all images are acquired along the longitudinal patient axis. The effects of pincushion distortion can be minimized by ensuring that there is a large degree of overlap between images. A combination of constant speed and sufficiently high frame rate is required.

Parallax errors

Parallax errors are caused by the divergent nature of the X-ray beam. As a result, object shape changes with view point. These effects show up in the direction of translation, and their size is related to the size of the step size between images. The effects of parallax distortion can be limited by keeping the displacement between consecutive images relatively small. This can be achieved by combining a constant tracking speed with a sufficiently high frame rate.

Lateral movement

Lateral movement causes reconstruction artefacts because only movement in the main direction of acquisition is detected by the spine image reconstruction algorithm. Every effort must be made to avoid lateral movement.

Viewing and measurements

Screen layout

You can choose from three different layouts for the composite and detail area:

– Single

The composite image area shows one composite image, the detail area shows the zoomed part of the composite image.

– Single with original

The composite image area shows one composite image, the detail area shows a detail of the composite image in its upper part and the lower part shows the original image which corresponds to the detail of the composite image.

– Double

The composite image area shows two composite images, the detail area shows the zoomed images.

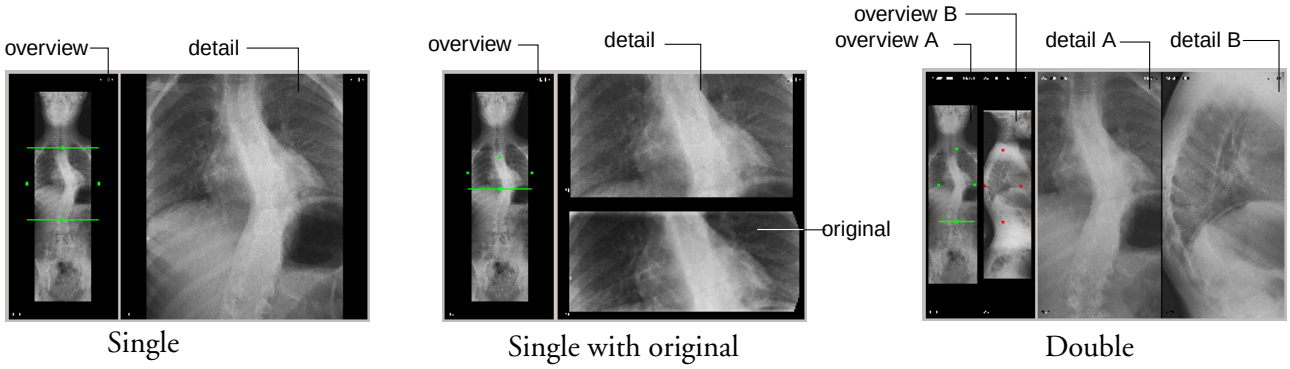


fig.7.8 viewing mode layout

Navigating through the composite image

The detail area shows a part of the image displayed in the composite area. The green rectangle in the composite image area represents the part of the composite image that is displayed in the detail area. This rectangle can be used to control which part of the composite image is shown in the detail image.
When you have selected the double viewing layout, both composite images show a control rectangle. The left hand composite image shows a green control rectangle, the right hand composite image shows a red control rectangle.
The following description about how to use the control rectangle refers to the green rectangle, the description applies to the red control rectangle as well.

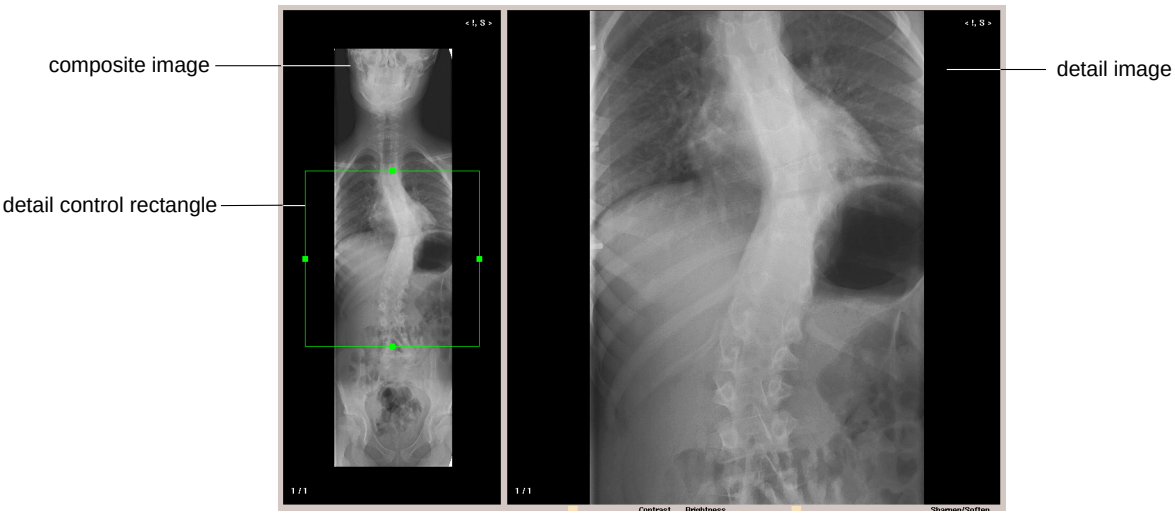


fig.7.9 Navigating through images

Zoom

The green rectangle shows four small green squares or handles on its edges.

Begin To change the enlargement of the detail image:

- Drag the control rectangle at one of its handles.

The rectangle changes symmetrically in size and on release of the mouse button the detail image is updated to show again only the part of the composite image within the control rectangle. **End**

Pan

The green rectangle can be used to determine which part of the composite image is shown in the detail image.

Begin

To show another part of the composite image as the detail image:

- Drag the control rectangle at one of its sides (but not at its handles)

On release of the mouse button the detail image is updated to show again only the part of the composite image within the control rectangle.

- or -

- Move the cursor in the composite image to the position where you want to have the centre of the detail image.
- Left click at this position.

The control rectangle in the composite image jumps to the new position and the detail image is updated accordingly.

End

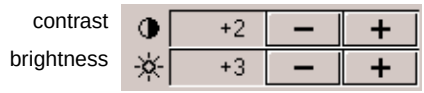
Image presentation

You can change the image presentation with the contrast / brightness controls, the edge enhancement controls, and the inverse video option at the bottom of the screen.

Contrast / brightness

Begin

To change contrast and brightness:



- Click the appropriate '-' or '+' button.

To reset the contrast and brightens to their original setting:

- Click the reset button.

To invert the black / white display of the images:

- Click the inverse video option.

End

Edge enhancement

Begin

To apply edge enhancement for increased visibility of details:

- Click the '-' or '+' button.

To reset the edge enhancement to the original setting:

- Click the reset button.

End

When used with the single or double composite image layout, the contrast / brightness, inverse video, edge enhancement settings and the shutter function apply to the composite images.

With the single and original image layout these settings apply to the original image only.

These image settings are stored in the database. When you retrieve the images from the database later, they will appear with the same settings

Change left / right orientation

You can change the left / right orientation of the displayed images in order to set them to the left / right display convention that you prefer.

To change the left / right orientation of the images:

- Click the mirror option.

The mirror setting is not stored in the database, when you retrieve the images from the database later, the original image orientation is used for display of the images.
If the mirror option is turned on, then the changed orientation is also applied when you print images.

If the mirror option is turned on, the images show a mirror symbol in the lower left hand corner (A mirrored '**p**' like symbol). This symbol is shown on the displayed images as well as on printed images.

Measurements

With the spine reconstruction package you can take measurements from the composite image. Special measurements for the evaluation of scoliosis are provided, such as the widely accepted Cobb method to measure the angle of curvature. Vertical alignment and femur head height difference can be measured, and the general purpose measurements can also be used. To obtain distance measurements in mm the image must be calibrated.

To start measurements:

- Click the spine measurements button.

The following panel appears:

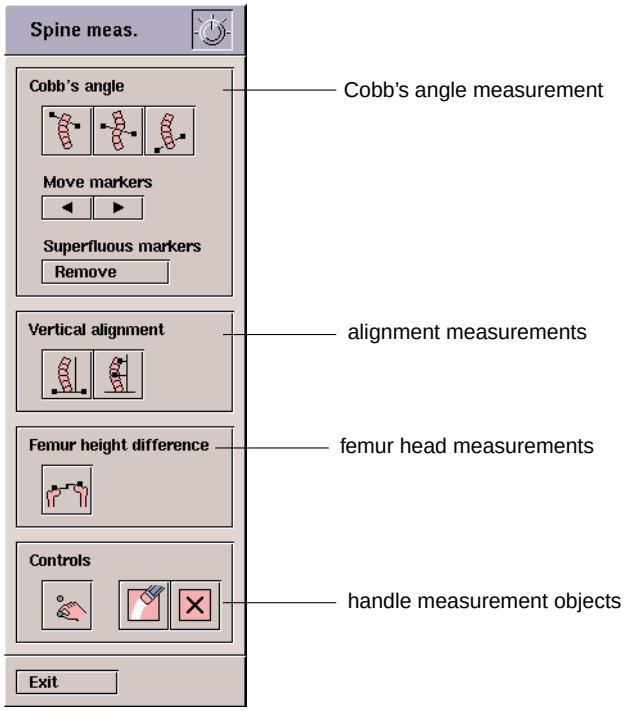


fig.7.10 spine measurements

This panel shows the buttons for measurements especially designed for the spine reconstruction package. In this section we will explain how to use the measurements specific for the spine package.

Measurement objects can only be created on images and removed from images in the detail image area. The special measurement objects behave in a similar way as the general purpose measurement objects.

Spine measurement functions

There are three measurement functions available for the evaluation of patients with scoliosis:

1. Cobb's method to measure spine curvature.
2. Vertical alignment
3. Femur head height difference.

Cobb's method

For the evaluation of the curvature of the spine in patients with scoliosis the spine measurement function includes an implementation of the Cobb method. You can measure a single curve with two markers or a double curve with three markers.

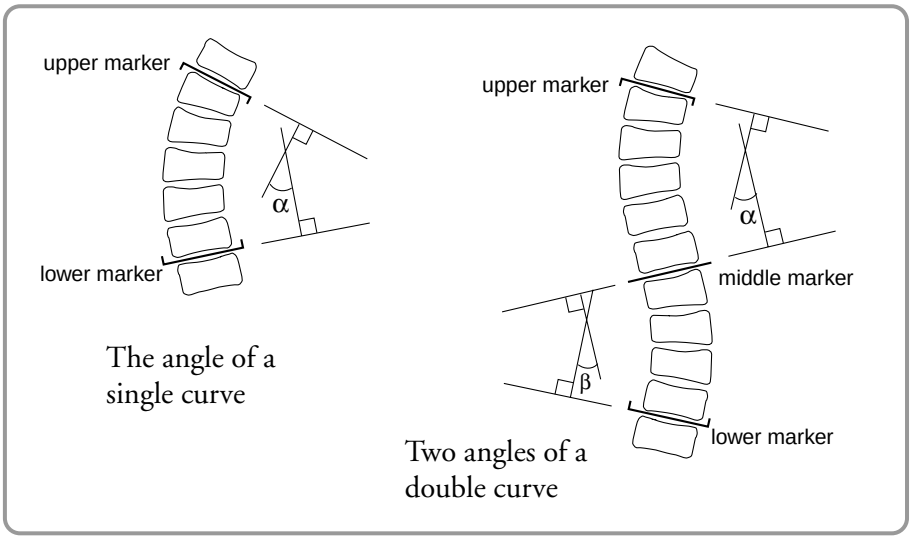


fig.7.11 Cobb's method

The figure above shows an example of a single curve measurement and a double curve measurement with the markers available in the spine measurement function. You are not restricted to measure one single or one double curve, you may combine as much upper, middle and lower markers as required to evaluate multiple curvatures.

Cobb's angle measurement

The measurement panel has a dedicated area for the measurement of Cobb's angle, which is shown as follows:

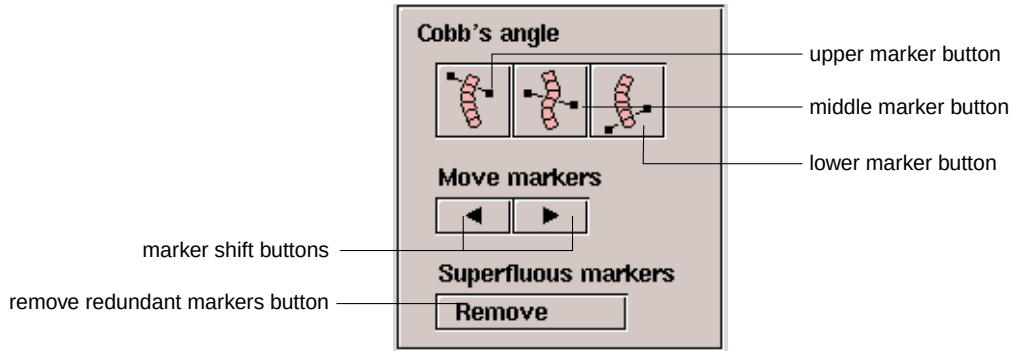


fig.7.12 Cobb's angle measurement.

Single curve measurement

Begin For the measurement of a single curvature:

- Click the upper marker button.
- Click two points along the upper plate of the vertebra that has the maximal tilting angle in the curvature that you consider (start of curvature).

- Click the lower marker button.
- Click two points along the lower plate of the vertebra that has the maximal tilting angle in the curvature that you consider (end of curvature).

You may change the order in which you put the markers into the image. After having entered both markers, the angle value is displayed in between the two markers

End

Double curve measurement

Begin

For the measurement of a double curvature:

- Click the upper marker button.
- Click two points along the upper plate of the vertebra that has the maximal tilting angle in the upper curve that you consider.

- Click the middle marker button.
- Click two points through the centre of the intervertebral space that shows the maximum tilting angle in the curves that you are considering.

- Click the lower marker button.
- Click two points along the lower plate of the vertebra that has the maximal tilting angle in the lower curve that you consider.

You may change the order in which you put the markers into the image. After you have entered the markers, the angle values are displayed in between the markers.

Angle value labels may hide anatomical details that you want to show.

- Drag a distance label to the left or the right

The movement of a label is restricted to keep it at the vertical level of the angle markers to which it belongs.

End

The Cobb's angle markers are considered as a single measurement object. If the markers are selected and you click the 'delete' button, all markers will be removed.

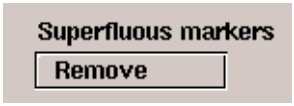
Multiple curve measurements

You are not restricted to use just a pair of an upper and a lower marker; or a combination of an upper, a middle and a lower marker. You may combine as much upper, middle and lower markers as required to evaluate multiple curvatures.

If you want to measure more than two Cobb's angles, you may use as much Cobb's angle markers to measure multiple curvatures on an image.

Find maximum angle

It is not always clear at which level the largest angle is obtained. You may add more markers of the same type, e.g. add another upper marker near the upper marker that you entered already. You may add additional middle and lower markers as well.
The angle value displayed is the maximum value between the upper / lower marker(s) and middle marker(s) in case of a double curve measurement or between the upper and the lower marker(s) in case of a single curve measurement.
To keep the markers which form the maximum angles and remove the other ones:



- Click the »Remove« button.

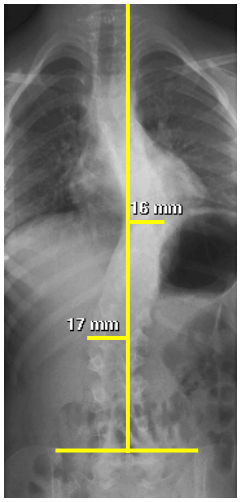
Vertical alignment

Begin

To evaluate the vertical alignment of the spine column:

- Click the alignment button.

  The cursor changes into a cross-hair.



- Click two reference points, i.e. the two upper points of the left and right sacroiliacal joint.

  A line connecting these two points is now shown and a vertical reference line is erected on the centre of this horizontal connecting line.

If necessary, use the navigating rectangle in the composite image to move to the position where you want to measure the vertical alignment.

- Click the measurement button.

  The cursor changes into a cross-hair.

- Click on a point at the left or the right of the spine for which you want to measure the lateral displacement.

  A horizontal line segment is shown together with the distance to the vertical reference line.

You can measure more lateral distances if you wish, by repeating the last two steps.

To remove an alignment distance line:

- Drag the handle of the distance line to the reference line until the distance label indicates 0 mm distance.\

Distance labels may hide anatomical details that you want to show.

- Drag a distance label to the left or the right

The movement of a label is restricted to keep it near the line to which it belongs.

End

Femur head height difference

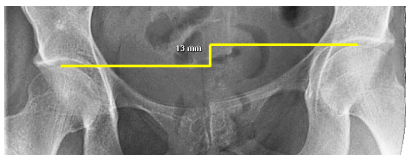
Begin

To measure the height difference of the femur heads:

- Click the height difference button.

The cursor changes into a cross-hair.

- Click two points, one on the top of the left femur head, the other on the top of the right femur head.



A horizontal line between the two points appears, if there is a height difference, the horizontal line is split into two segments, which are connected by a vertical line. The height difference is shown at the centre.

End

General purpose measurements

In addition to the dedicated measurements for scoliosis, you can also measure distances, angles and areas with the standard EasyVision measurement tool.

To activate these measurements:

- Click the measurements button.

Calibration

For proper measurements of distances, the image must be calibrated. To this end a ruler or another suitable object of a known size must be exposed together with the patient when the scan is made.The calibration is required if you want distance measurement results in mm. Angle measurements can be done without calibration. You may calibrate an image before or after you have put the measurement graphic objects on the image.

For optimal accuracy, the calibration object should be positioned at the level of the patients spine. This will reduce inaccuracy due to parallax image distortion.

To calibrate the image:

- Click the calibration button.

The calibration function is now active. Proceed as described in Chapter 5, ‘Standard functions, section ‘Calibration tool’ about how to perform the calibration.

Distance values are displayed in mm after you have finished the calibration.

Prepare for measurement review

For printing of measurement graphics on images it may be desirable that markers are moved from their positions as they were entered; they may obscure anatomical details which must remain visible.

Move markers

Begin

You can move the Cobb's angle markers along their own line:

- Click one of the marker shift buttons.

The markers are set aside to the left or to the right of the spine.

The values that are displayed for the Cobb's angles, femur height difference and vertical alignment may also be displayed at undesirable places.

To move value labels:

- Drag a value label to the left or to the right.

You can not drag a value label to any position on the image, their movement is restricted to keep them near the measuring point to which they belong.

End

Hide graphics

You can temporarily hide graphical objects. This is useful to judge the placement of markers, and to put images on film with or without graphical objects when using the manual print compose tool.

To temporarily hide the measurement objects from the composite image:

- Click the hide graphics button.

Printing images

You can print spine composite images on film with the manual print compose function and with predefined film layouts if the EasyPrint option is installed on your system.

Manual printing

Begin To print with the manual print compose function:

- Click the print compose button.

The print compose panel appears.

End

- Compose film(s) as you need them.

Protocol print

The spine protocol print function offers the following predefined layouts:

– One composite image on a film
– The same composite image two times printed on a film, the one with measurement graphics, the other without them.
– Two different composite images on a film.
– One composite image with originals.

Begin To print with a predefined layout:

- Click the protocol print button.

The protocol print panel appears:

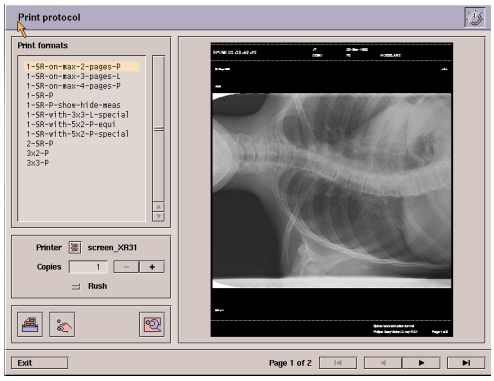


fig.7.13 Protocol print panel

To change the layout:

- Click the print properties button.
- Change the settings as you want them on the properties panel:

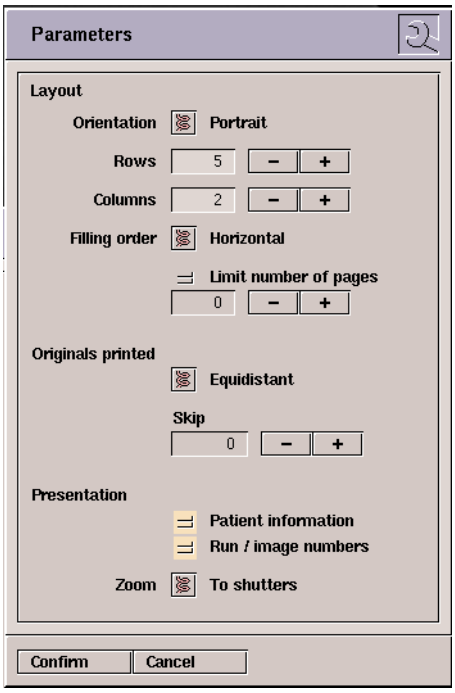


fig.7.14 Print properties panel

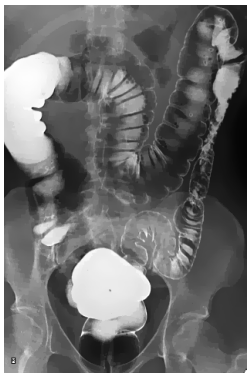
End

- Click the »Confirm« button.

You can not initiate printing of a composite image from the acquisition system, you must either use the manual print compose function or the protocol print function after having reconstructed a spine composite image.

Chapter 8
Colon overview image

Introduction



The colon overview image function is designed to reconstruct an overview of the abdominal area in colon examinations. With this function an overview is reconstructed from a series of X-ray images especially taken for this purpose. This reconstruction overview image can be used for the evaluation of gross anatomy and can serve as a roadmap for the positioning of detail images made during the rest of the examination.

Before sending the scan from the DSI system to the EasyVision workstation it must be flagged to be converted into an overview image. When the whole examination is sent to the EasyVision workstation, the overview image that is created will be stored in the EasyVision database. After creation and storage of the overview image, this image will be printed on film.

Once initiated from the DSI system, this process runs completely automatic. No interaction on the EasyVision workstation will be required. Errors during processing or printing will be reported to the DSI console.

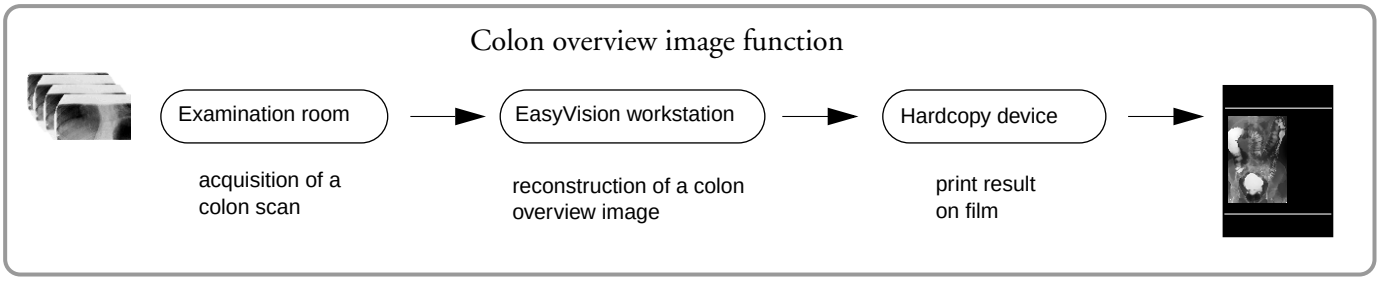


fig.8.1 Overview of the colon function

The algorithm for composing a colon overview is specifically designed for a series of images of the abdomen acquired with a prescribed acquisition protocol. It takes specific features of these images into account. Therefore it should never be used for reconstruction of other types of images nor should measurements be made from this image.

Spine overview images or bolus chase reconstruction images must be reconstructed in the appropriate packages.

Colon overview image

Acquisition systems

The colon overview function can be used with the following URF systems:

– Multi Diagnost 3 and 4

– Diagnost 66, 76, 94, 96, 97

in combination with

– DSI release 4.4

The colon overview function is only supported by DSI release 4.4.

Requirements for colon image reconstruction

In order to successfully produce a colon overview image, a number of requirements must be fulfilled. Some of these requirements can be checked by the EasyVision software, so that the automatic reconstruction of a colon overview image will be performed only if these requirements are fulfilled. In case a reconstruction fails, the original images will be stored in the EasyVision database. The requirements for the automatic reconstruction of a colon overview image are listed in the following sections.

Acquisition requirements

This section mentions the requirements for the acquisition protocol.

– The colon scan must be acquired with a 38 cm image intensifier.

– The colon scan must be acquired with a movement in the longitudinal direction only, from top to bottom.

  This movement may be accomplished by moving either the table or the X-ray source and image intensifier, depending on the system being used. Lateral movements will cause the reconstruction to fail.

– The number of images per second and the scan speed must be such that the displacement between two successive images is at most 1/8 of the image height.

– The number of images per second and the scan speed must be such that all distances between two successive images are equal.

These requirements can not be checked by the EasyVision software, it is the user's responsibility that they are fulfilled. The reconstruction may fail if there are deviations from these requirements.

Restrictions on images

The following requirement applies to the scan images:

- The images must be X-ray images; secondary capture images cannot be used for a colon overview image.
- The images must be contained in a run, and all images:
  - must have the same matrix size and pixel depth.
  - must be ordered according to creation time, and have consecutive image numbers.
  - and the run must contain more than one image.

These requirements are checked by the EasyVision software. If one or more of these requirements is not fulfilled, no processing is performed and a “Send error” is returned to the DSI system.

Acquisition protocol for colon overview imaging

To obtain a good reconstruction image, a well defined acquisition protocol must be followed. Upon reconstruction it is not possible to check whether all requirements are met; this is the user's responsibility.

Patient scheduling

Select the correct examination type on the patient administration page on the DSI console (Administration F1). The examination type determines which processing is performed by the EasyVision software on import of the examination. See also Chapter 1, 'Start-up and customizing' about how to setup your system for automatic creation and printing of a ColonMap image.

Preparation

- Adjust the collimator to 50% of the total height of the image intensifier field in the vertical patient direction.
- Set up appropriate exposure and kV values.
- Select the desired image matrix (512^2 or 1024^2).
- Set acquisition speed to 2 images/s.

For D94 / 96 / 97 and MD3 / 4 systems:

- Set scanning speed to 4 cm/s.

For D66 / 76 systems:

- Use the table longitudinal movement to obtain a scan. Lock the lateral movement before starting a scan.

You can also use other values for scanning speed and acquisition speed provided the images have sufficient overlap. E.g. you can use a scanning speed of 6 cm/s and an acquisition speed of 3 images/s.

Acquisition

After you have prepared the system as described above:

- Start scanning at the top of the abdomen and move the tube/image intensifier combination or the table (depending on the acquisition system) until the whole abdominal area is scanned.

Post acquisition

Before you send the examination to the EasyVision workstation you can set or change image presentation parameters and flag images for reconstruction.

- Change contrast / brightness and edge enhancement settings for optimal image display.
- Choose desired image polarity setting.
- Set up horizontal and vertical shutters to ensure correct settings for printing via EasyVision (zoom to shutters, to use the film format optimally).
- Set the DSI "flag" for each abdominal scan that must be converted into a colon overview image.
- Ensure that you have set the 'Colon' examination type. The examination type determines which processing is performed by the EasyVision software on import of the examination.

When no flag or no examination type is set, no reconstruction will be performed, the examination will not be stored in the EasyVision database and no automatic print will take place. A "send error" or "print error" message will be displayed on the DSI console.

- Annotations:
  If you want to have annotations on the overview image, put your annotations on the **last** image of an abdominal run. EasyVision will copy the annotations from the last image to the same position on the overview image.
- Select the Copy page F2

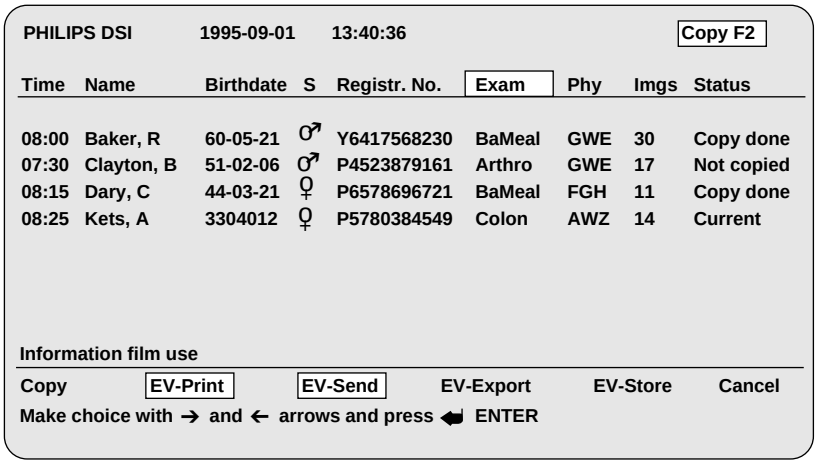

PHILIPS DSI 1995-09-01 13:40:36 Copy F2
Time Name Birthdate S Registr. No. Exam Phy Imgs Status
08:00 Baker, R 60-05-21 ♂ Y6417568230 BaMeal GWE 30 Copy done
07:30 Clayton, B 51-02-06 ♂ P4523879161 Arthro GWE 17 Not copied
08:15 Dary, C 44-03-21 ♀ P6578696721 BaMeal FGH 11 Copy done
08:25 Kets, A 3304012 ♀ P5780384549 Colon AWZ 14 Current
Information film use
Copy EV-Print EV-Send EV-Export EV-Store Cancel
Make choice with → and ← arrows and press ↵ ENTER

fig.8.2 DSI Copy F2 page

- Select the examination in the Copy page
- Set "EV send" / "EV print" / "EV export" / "EV store"

The whole examination will be sent to the EasyVision workstation and the flagged run(s) will be reconstructed during import.

If any error occurs during reconstruction, the whole examination will not be stored at all. You will be notified at the DSI console with the "Send error". The "Processing queue" status panel on the EasyVision workstation will show more information about the error.

The original images from which the overview image is reconstructed, will not be stored in the EasyVision database. The overview image will be stored instead!

Image quality indicators

A reconstructed colon overview image is provided with Image quality indicators:

- A colon overview image is always marked with the "survey image" indicator **<S>**.
- If the shifts were not all equal, it is marked with the 'Limited' reliability indicator **<!>**.

Image attributes and presentation

As regards to image attributes and presentation settings, the following applies to the colon overview image:

- The reconstruction image will have the same patient, examination and run attributes as the originals.
- The contrast and brightness have a fixed setting, optimized for printing. The image B/W polarity is copied from the acquisition setting of the last original.
- A fixed setting for edge enhancement.
- Horizontal and vertical shutters are taken from the last original
- Circular shutters and rotate/mirror settings will not be applied.
- Zoom to shutters is set for optimal printing.
- The DICOM Image type of the colon overview image is set to DERIVED, SECONDARY image.

Preparing for reconstruction and auto print

Automatic reconstruction and printing of colon images is determined by the examination type of the data sent by the DSI system. How to set up the relation between examination type and reconstruction; and printing colon overview images is described in Chapter 6, 'Setup and customizing'

Note that the reconstruction of colon overview images can only be initiated by DSI release 4.4 systems.

Printing images

Additional films with colon overview images can be printed with the standard EasyVision print protocol function. This function is available a.o. in the R/F viewing package and the Data handling package.

Printing formats

Two print formats are delivered with the colon overview image reconstruction option

– The film sheet is divided in a matrix, for regular images the print matrix can be changed from a single image to maximal 6x6 images on a filmsheet. Two vertically adjacent positions of the image matrix are joined to show a colon overview image.
  All colon overview images will be printed from left to right on a film sheet. If the number of colon overview images exceeds the number of columns in the image matrix, additional film sheets are use in the same way. The remaining positions will be used for regular images.

– Each overview image on a single sheet; all other images on a matrix of 3x3. The print matrix for regular images can be changed from a single image to maximal 6x6 images on a filmsheet.

Chapter 9
NetView

EasyVision World Wide Web access

Purpose

To define a Username and Password on EasyVision (in Customizing) to give a user access to EasyVision WWW capabilities.

Procedure

1. Exit the application,

   -> the 'Start up' panel appears.
2. Type 2. and press Enter,

   -> Customizing is started.
3. Go to 'User Permissions' on the screen and click 'Login'.
4. Insert:

   Username: MasterUser
   Password: MasterUser
5. Click 'Login'.
6. Define a Username and Password.
7. Define login 'User permissions':

   -> 'WWW directory browser': to copy files to PC.
   (for all users)
   - and/or -
   -> 'NetView': to enable the NetView application.
   (Software key required).
8. Click 'Add' to register the user.
9. 'Exit' the panel.
10. Click 'Save' at the top of the screen.
11. Exit customize.

Remarks

Note that all users are able to copy files to a PC, but a 'NetView' software key is required to access the NetView application.

For more information see:
System requirements for NetView
Copy files from EV to PC.

System requirements for NetView

- PC (Pentium) or Workstation (SUN SPARC station).
- Operating system: Windows ‘95, Windows NT, Solaris 2.5.x.
- Netscape Navigator 4.01, Internet Explorer 4.0 or higher.
- At least 800x600 display with at least 64 KB colors (high colour, 16 bit).
- At least 32 MB of memory (64 MB recommended).
- At least 128 MB of swap disk space.

Purpose of NetView

Allows images in the Easyvision database to be viewed on a PC (using the NetView application).

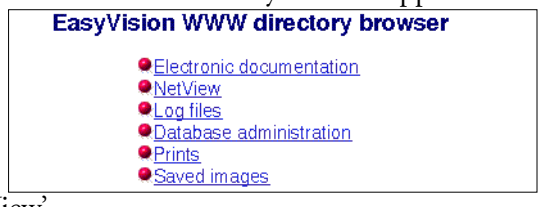
Procedure

1. Enter the following address to enable the EasyVision WWW directory browser:

http://ipaddress:5000/easydata/www/java/EVHome.html
Where **'ipaddress'** *is the ip address of your EasyVision station (or the ip address of the server for a client-server configuration).*

2. Press Enter
3. Enter Username and Password, (The first time)
4. Click on "Bookmarks" and "Add Bookmark". The first time for (future use)

   ->The EasyVision WWW directory browser appears:



5. Click 'NetView',

   -> the NetView homepage appears:

6. Click 'Push',

   -> the NetView application starts.
7. Enter Username and Password.
8. Click "Login".

Remarks

Note that a 'NetView' software license key is required to enable the NetView application. A maximum of 5 concurrent users is permissible per key by default. Also a user login permission is required.
For more information see:
System requirements for NetView
Copy files from EV to PC.

Copy files from EV to the PC

Purpose

To copy ASCII, TIF, JPEG and MPEG files from EasyVision to a PC via a (PC) Web Browser (Netscape, Explorer, HotJava)

Procedure

1. Enter the following address to enable the

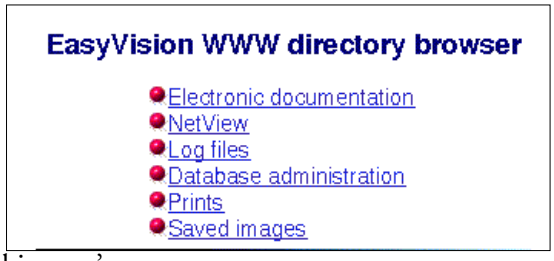
EasyVision WWW directory browser:

http://ipaddress:5000/easydata/www/java/EVHome.html

Where **'ipaddress'** *is the ip address of your EasyVision station (or the ip address of the server for a client-server configuration).*

2. Press Enter
3. Enter Username and Password, (The first time)

-> The EasyVision WWW directory browser appears:



4. Click 'Saved images'.

   -> the 'Directory listing' appears,
   which allows files to be copied.

Remarks

Note that all users are able to copy files from
EasyVision to a PC, even without a NetView license, but user login permission is required.

For more information see:
System requirements for NetView.